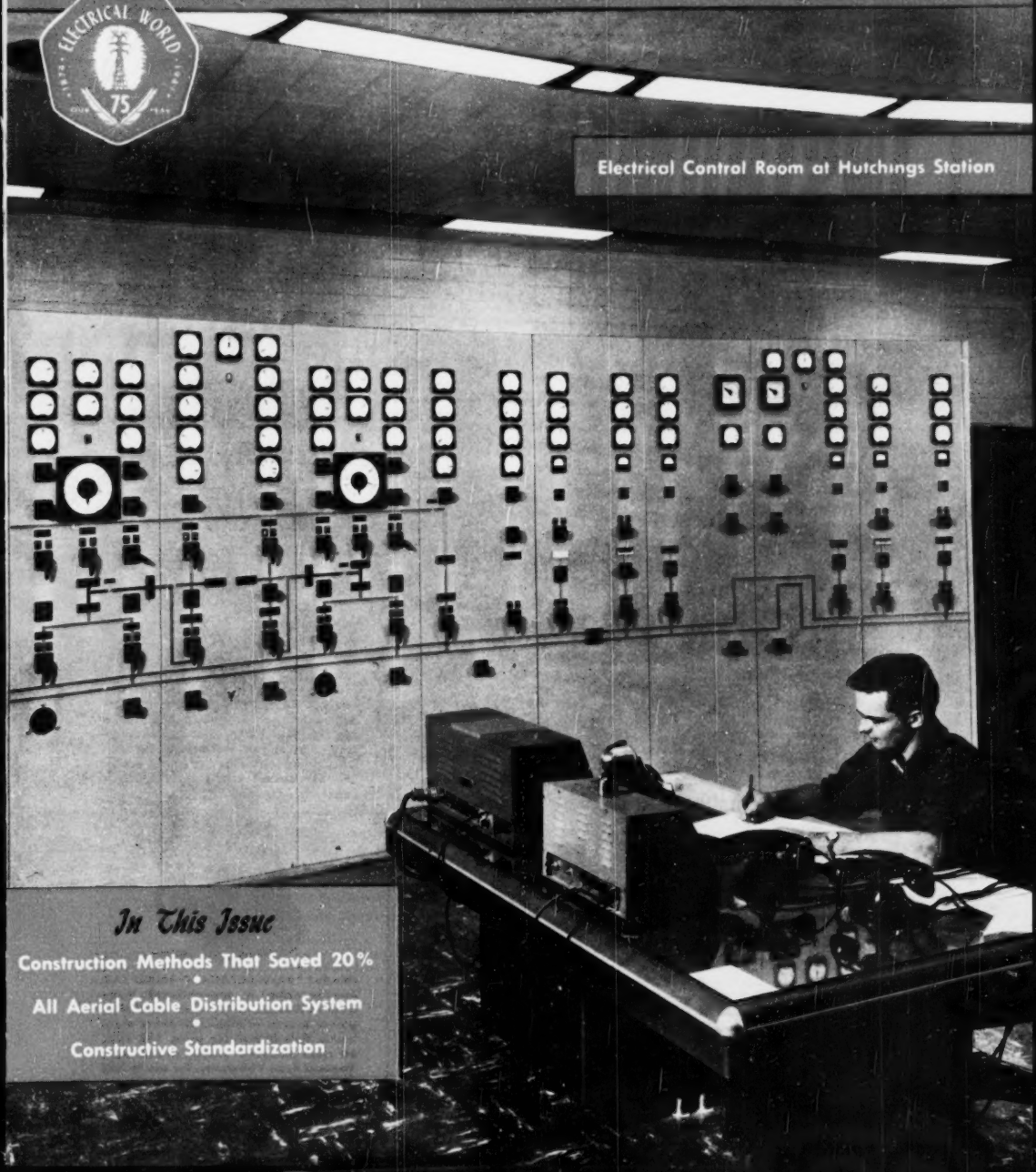
ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

DECEMBER 3, 1949



Electrical Control Room at Hutchings Station

In This Issue

Construction Methods That Saved 20%

•

All Aerial Cable Distribution System

•

Constructive Standardization

(Model 901) PORTABLE TEST INSTRUMENTS available in DC, Model 901—and AC, Model 904, single and multiple ranges of wide coverage. Excellent scale readability and shielding. Accuracy within ½ of 1%.

SENSITIVE RELAYS a line of sensitive relays including the Model 705 which provides positive control at levels as low as ½ microampere. Non-chattering magnetic contacts handle up to 10 watts at 120 volts.

(Model 622) ULTRA-SENSITIVE INSTRUMENTS portable DC and AC Thermo instruments for precision measurement of potentials and minute currents involving electronics, thermo-couples or laboratory research.

INSTRUMENTS

TO SPEED AND SIMPLIFY ELECTRONIC PRODUCTION AND MAINTENANCE

Illustrated are but a few of the many specialized instruments available from WESTON . . . all designed to simplify and speed-up electrical and electronic installations, production testing, and maintenance. For details, see your local representative, or write Weston Electrical Instrument Corporation, 578 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON *Instruments*

ALBANY • ATLANTA • BOSTON • BUFFALO • CHARLOTTE • CHICAGO
CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • HOUSTON
JACKSONVILLE • KNOXVILLE • LITTLE ROCK • LOS ANGELES
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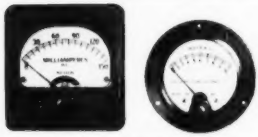
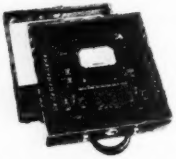
SAN FRANCISCO • SEATTLE • ST. LOUIS • SYRACUSE • TULSA
IN CANADA, NORTHERN ELECTRIC CO., LTD., POWERLITE DEVICES, LTD.

(Model 798) MULTI-PURPOSE TUBE-CHECKER offering provision for testing Receiving Tubes — Voltage Regulator Tubes—Light Duty Thyratron Tubes such as 2A4—6D4—884—885—2051. Scale is calibrated "Good-Bad" as well as in mutual conductance range.



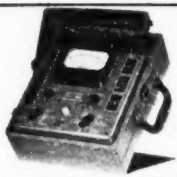
PANEL and SWITCHBOARD INSTRUMENTS a complete line of instruments in all types, sizes and ranges required for switchboard and panel needs . . . including DC, AC power frequencies and radio frequency, rectifier types and D.B. meters.

(Model 697) VOLT-OHM MILLIAMMETER one of a line of pocket-size meters, Model 697 combines a selection of AC and DC voltage, DC current, and resistance ranges. Ideal for maintenance testing and many inspection requirements.



(Model 785) INDUSTRIAL CIRCUIT TESTER a versatile, portable tester for laboratory or maintenance needs, where an ultra-sensitive instrument is required. Provides 27 AC and DC voltage, AC and DC current, and resistance ranges. (DC sensitivity 20,000 ohms per volt.)

(Model 779, Type 1) SUPER-SENSITIVE ANALYZER small, light, compact, 26 range Volt-Ohm-Milliammeter with 5 DC voltage ranges, sensitivity of 1000 or 20,000 ohms per volt. AC temperature compensated. Self-contained power supply. Ideal for many production and test requirements.



(Model 769) ELECTRONIC ANALYZER incorporating a conventional Volt-Ohm-Milliammeter with self-contained power source—a high-impedance electronic Volt-Ohmmeter using 115 volt, 60 cycle power—a stable, probe-type, Vacuum Tube Voltmeter, for use to 300 megacycles.

ELECTRICAL WORLD

Published for 75 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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COVER—Air conditioning, superlative lighting and modern communications make Hutchings Station control room an efficient operating center

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HAZEL-ATLAS
Installs

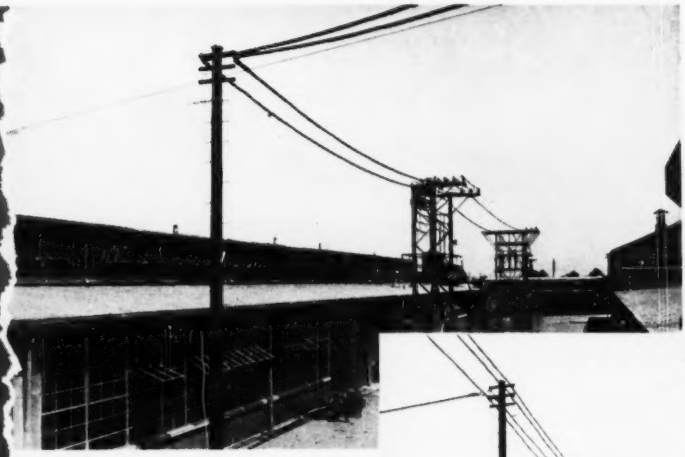
OKOLITE-OKOPRENE

SELF-SUPPORTING AERIAL CABLE

for
compactness
durability
dependability

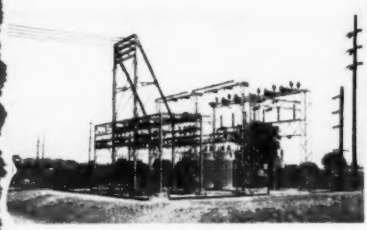
ENGINEERS
PETER F. LOTTUS CORP.,
PITTSBURGH, PA.

ELECTRICAL CONTRACTOR
HARRY ALEXANDER, INC.,
WASHINGTON, D. C.

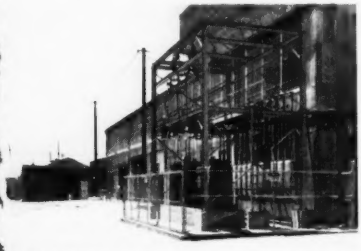


COMPACTNESS — self-evident space economy eliminates congestion, reduces clearance problems, gives a neater, more streamlined appearance in keeping with modern efficiency. Simple line tap, permitted with Okonite's Dualay* construction, serves the 2300/440 volt steel platform substation.

DURABILITY — no ring-cutting; permanently weatherproof, non-conducting Okoprene sheath; high-voltage, heat and moisture resisting Okolite insulation. These Okonite values mean long-lived, trouble-free circuits. Four circuits above are carried from station (background) on pedestal-mounted tubular steel poles with steel cross arms welded in place.



DEPENDABILITY — "stormsafe," fewer service interruptions or outages, improved circuit regulation because of lower reactance; freedom from lead sheath troubles. 44kv/2.3kv jointly operated transformer and switching substation containing the Alabama Power Co. step-down transformer and the Hazel-Atlas Glass Co. outdoor oil circuit-breakers shown above.



ECONOMY — save on installation as well as maintenance costs with Okonite S/S cable. Reasonable first cost; simple, quick installation. Long spans require fewer poles; fewer items to be purchased and stocked. Exclusive Dualay assembly permits ample separation of conductors without cutting copper conductors or performing any operation on messenger. Practically no maintenance is required.

*U. S. Pat. 2430378

Four thousand feet of Okolite-Okoprene "Line-Tap" Self-Supporting Aerial Cable serve the new plant of the Hazel-Atlas Glass Company at Montgomery, Alabama. According to company officials, this installation provides a compact, durable and dependable arrangement, in keeping with the modern efficiency of the plant. It represents another proof of the advantages of Okonite Self-Supporting Cable for industrial applications.

Outdoors, on poles or on brackets attached to buildings – or indoors, where circuits can be carried overhead supported by beams or trusses – Okolite-Okoprene Self-Supporting Aerial Cables provide a modern, dependable and economical method of industrial power transmission. They are described in a 52-page manual available to electrical engineers and company executives. For your copy, send a request on your letterhead to The Okonite Company, Passaic, N. J.

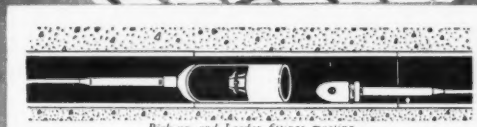
THE BEST CABLE IS YOUR BEST POLICY

OKONITE SINCE 1878 *insulated wires and cables*

7869

Electroline Duct Rodding

DOES IN THIRTY MINUTES WHAT USED TO TAKE TWO WEEKS



Pick-up and Leader fittings meeting

Right, Electroline Steel Rodding Equipment feeds easily around the bends.

Below, Leader locked in Pick-up for either push or pull.

PATENT APPLIED FOR

Utilities have found that one gang, with Electroline Steel Duct-Rodding Equipment, can make a half-hour job out of one that formerly took two gangs two weeks with old-style equipment!

In consequence, they have made amazing savings in labor cost alone. Add to this lower first cost, the lower handling cost, and longer life . . . then you have their reason for adopting Electroline's speedy, economical Duct-Rodding Equipment.

The construction is simple and trouble-free, yet affords the outstanding advantages of easy, efficient rodding and great durability in service.

Originated by Electroline — Always Ahead of the Field. Write for bulletins.

Electroline Company

Originators and Patentees of Automatic Line Splices and Dead Ends

4121 SOUTH LA SALLE STREET • CHICAGO, ILLINOIS

IN CANADA — **POWERLITE DEVICES, LTD., TORONTO**

NOW! { 4500 amperes / 6900 amperes / 8600 amperes } POWER FUSE protection for $11.60 / protection for 16.80 / protection for 20.25

Can you

PRICES ARE WAY DOWN — on S&C Liquid Power Fuse equipment for 7,500- and 15,000-volt installation, making its dependable performance available for wider application.

Now there is no need to gamble on cutouts where high short-circuit currents are available. Nor is there need to pay a heavy premium over cutout prices to get reliable power fuse protection for 6,900- to 13,800-volt distribution transformer and substation installations.

Two innovations have made the advantages of the Liquid Power Fuse available at the new low prices shown below: (a) The new Simplified Mounting, pictured and described here, which is **better,** yet cheaper, than the conventional switch insulator type mounting it replaces and, (b) a new plan for the purchase of Liquid Fuses which reduces prices and does away with the need for returning blown fuses to the factory for refill.

Comparison of interrupting ratings and costs① of the Liquid Fuse with other typical protective devices follow:

	Ordinary Open Drop-Out Cutouts		Drop-Out Power Fuses				Liquid Power Fuses With Simplified Mounting			
			Expulsion Type Using			Solid Material Type				
			Fuse Link		Fuse Unit					
Ampere Rating Range	To 100E	100E to 200E	To 100E	100E to 200E	½-125E	½-200E	1-10E (Size 1)	10-20E (Size 2)	½-50E (Size 3)	½-125E (Size 4)
					7500 VOLTS					
Interrupting Ratings in amperes, rms, asymmetrical	2000	4000	4000	6000	5000	12,000	4500	4500	6900	8600
First Cost②	$13.75	$21.30	$44.38	$44.92	$44.50	$54.00	$11.60	$12.45	$16.80	$20.25
20-Year Equipment Cost③	14.02	22.11	45.14	46.00	47.80	57.60	13.34	14.70	21.00	26.25
					15,000 VOLTS					
Interrupting Ratings in amperes, rms, asymmetrical	2000	4000	4000	6000	8000	11,000	3900	3900	5900	7400
First Cost②	$16.95	$26.13	$47.46	$48.00	$47.50	$60.50	$12.95	$14.45	$18.80	$22.95
20-Year Equipment Cost③	17.22	26.94	48.22	49.08	50.80	64.40	15.05	17.75	23.75	30.15

① Costs computed from prices in effect September 1949, using maximum discount quantities.
② Includes mounting and fuse, fuse link, refill unit, or fuse unit.
③ First cost plus 20-year cost of re-fusing.

DESIGNED FOR

FULL COVERAGE

FULL COVERAGE FUSING IS: the **new concept of transformer fusing** in which a primary fuse is applied for **both** primary short circuit and secondary back-up short circuit protection.

FULL COVERAGE FUSING PROVIDES—in addition to primary short circuit and secondary back-up short circuit protection—savings in operating expense by:

(1) Eliminating the need for replacement of "suspect" fuses, links, or refills on other phases when one fuse blows.

(2) Eliminating the need for periodic replacement of fuses, links, or refills to prevent "sneak-outs" caused by vibration- or age-weakened fusible elements.

(3) Eliminating "sneak-outs" caused by high current surges.

FULL COVERAGE FUSING REQUIRES: dependable high and low fault-current interrupting ability; a fine degree of accuracy in time-current characteristics; a "non-damageable" fusible element which cannot be injured by surge currents, vibration, or aging; and a full range of speeds—standard, slow, and time-lag—to provide flexibility in coordinating with other primary, and with the secondary, protective devices.

OTHER BENEFITS YOU GET WITH S&C LIQUID POWER FUSES:

1. **Short Arcing Time**—Shortest of **any** power fuse or cutout.
2. **No Interference from Sleet or Glaze**—because drop out action not needed to prevent tracking or to indicate a blown fuse.
3. **All Low Fault Currents Cleared**—unlike expulsion type devices, Liquid Fuses clear **all** types of low fault currents dependably.
4. **Stable Time-Current Characteristics**—achieved through S & C "Non-Damageable Fusible Element Construction", permit close, permanent, coordination; and eliminate "sneak-outs" (unnecessary outages).
5. **Fire Hazard Minimized**—no hot metal ejected to cause grass or underbrush fires.

S&C ELECTRIC

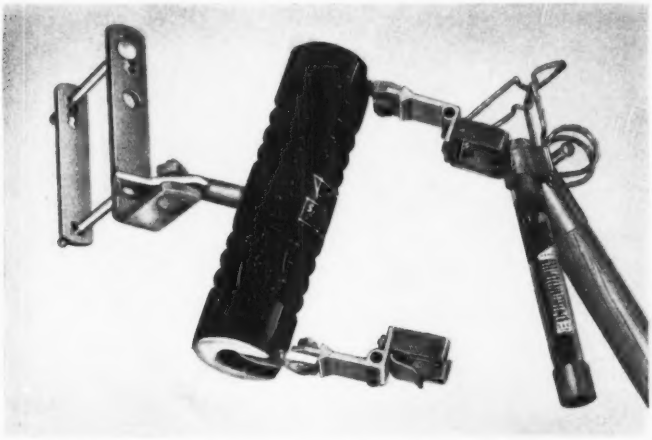
Formerly SCHWEITZER & CONRAD, INC.

longer afford to gamble on—

cutouts to protect investment and service continuity where high fault currents are possible?

NEW SIMPLIFIED MOUNTING FOR S&C LIQUID POWER FUSES

One reason for the low prices of this fuse and mounting combination is the new Simplified Mounting. As shown by the illustration, it is smaller and lighter than other type mountings. Yet streamlining has actually improved its insulation values by increasing leakage distances and flashover characteristics. In fact, its insulation values greatly exceed NEMA Standards for cutouts, and equal NEMA Standards for switch and bus insulators.



7,500-volt, 20E-ampere, Size 2 Liquid Power Fuse and Simplified Mounting. Total cost of mounting, hanger, fuse and clips—$12.45. Interrupting rating—4500 amperes.

Its first cost is lower. Its installation costs are lower.

It is bird- and animal-proof because the mounting bracket is located on the opposite side of the insulator from the live parts.

A NEMA Standard hanger and adjustable mounting bracket provide exceptional flexibility in positioning on cross arm, pole, or structure.

New fuse clips provide easy fuse handling with any ordinary hook stick.

Write today for full information given in new Catalog Section 223.

NEW NON-EXCHANGE PLAN FOR PURCHASE OF S&C LIQUID POWER FUSES

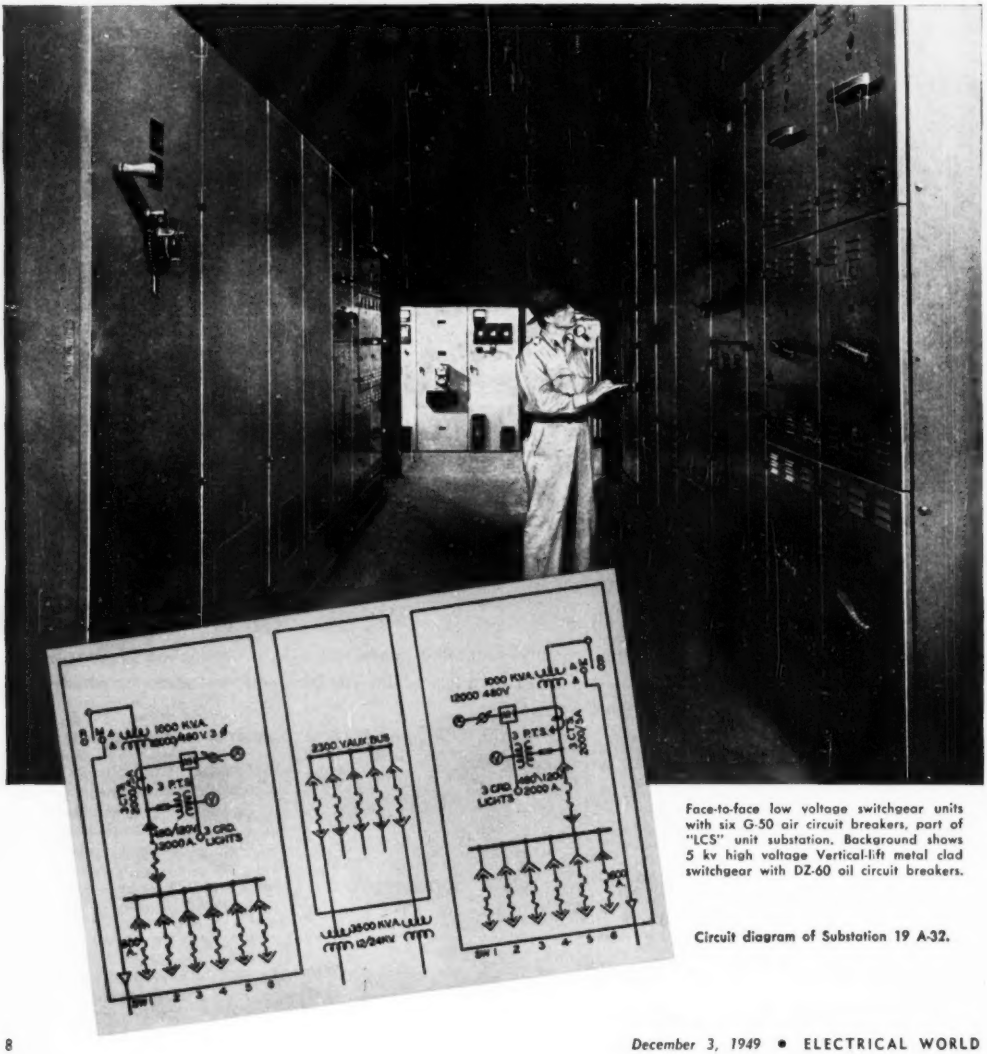
Another reason for the low prices of this new fuse and mounting combination is the reduction in costs made possible by the elimination of factory refilling of S&C Liquid Fuses. This can be done now under an alternative purchasing arrangement known as the Non-Exchange Plan.

This plan will be a money saver for most users of type B, COR, and D Liquid Fuses (of any voltage or size). Ask your S&C Representative for details, or write the factory.

COMPANY 4421 Ravenswood Avenue
Chicago 40, Illinois, U. S. A.

IN CANADA Powerlite DEVICES LIMITED, TORONTO •

Here's the Inside Power Protection at



Face-to-face low voltage switchgear units with six G-50 air circuit breakers, part of "LCS" unit substation. Background shows 5 kv high voltage Vertical-lift metal clad switchgear with DZ-60 oil circuit breakers.

Circuit diagram of Substation 19 A-32.

Story on

CORN PRODUCTS REFINING CO.

All power at Corn Products Refining Co.'s Argo, Illinois, plant is controlled by Allis-Chalmers High and Low Voltage switchgear — insuring constant power for production of Karo Syrup, Mazola Salad Oil, Kre-Mel dessert, Argo and Linit Starches.

IF YOU COULD GO behind the scenes at Corn Products, you would see why these household products owe their pure quality to *controlled* production. Many complex operations involve grinding mills, filters, converters and oil expellers to transform corn into starches, syrups, sugars, dextrines and oil . . . all of which must be supplied unfailing electric power!

Protection for Equipment.

Engineers at Corn Products, like many others, have turned to Allis-Chalmers switchgear to protect this costly equipment. There are 15 groups of low voltage switchgear housing 90 G-50 600-volt air circuit breakers in addition to primary high voltage Vertical-lift switchgear with 600 and 1200 ampere oil circuit breakers.

In Argo's building 53, starch is converted to syrup. Boiler house and substation on right.

This standard Allis-Chalmers switchgear is engineered to provide complete protection to operating personnel and equipment.

Standardized.

With today's increasing demand for electric power, industries need better power protection. For a *sure* answer look into the advantages of Allis-Chalmers standardized switchgear.

Easy to install. All-steel enclosed. Safety-engineered. Breakers mechanically trip-free. These features add up to give you economical power protection. Call your nearby Allis-Chalmers district office or write direct.

Low voltage switchgear with G-50 air circuit breakers and 1000 kva dry type transformer.

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

First in the U. S. with Metal-Clad Switchgear

A-2805

PROOF that you get

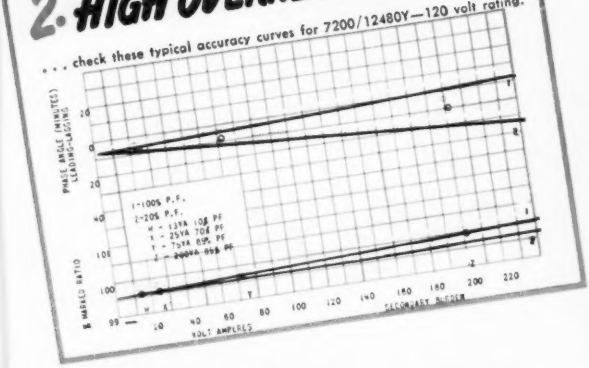
1. HIGH THERMAL CAPACITY

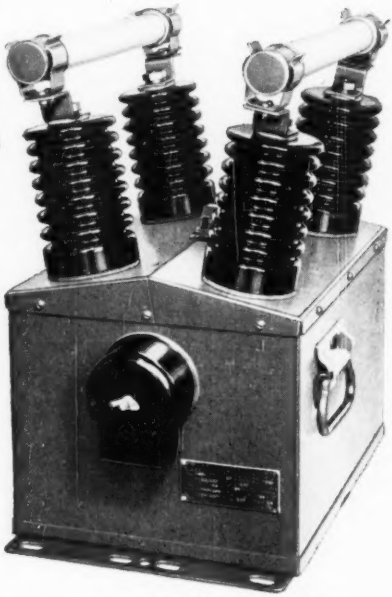
. . . thermally capable of supplying several times nominal rating continuously!

Voltage	Nominal Rating	Thermal Capacity
240 to 2400	200 VA	500 VA
4800 to 7200 (line to line)	200 VA	600 VA
7200 (line to neutral) to 14,400 v.	200 VA	1000 VA

2. HIGH OVERALL ACCURACY

. . . check these typical accuracy curves for 7200/12480Y—120 volt rating.





Type PD potential transformer with current limiting fuses, rated 14400 — 120 volts.

with Allis-Chalmers Indoor Potential Transformers

RESERVE THERMAL CAPACITY and uniformly low phase angle and ratio errors are among the first qualities you demand in potential transformers.

They're qualities you GET when you specify Allis-Chalmers type PD's!

One of the reasons is A-C's "balanced design." Materials are distributed in such a manner as to obtain closely balanced characteristics over the entire operating range. This, plus built-in high thermal capacity makes type PD transformers ideal for heavy duty, accurate metering service.

Proof of these claims is offered in the charts above.

For complete information on design, construction and mounting features, contact your nearby A-C sales representative.

Or write direct for new Instrument Transformer bulletin 61B7168, listing over 400 types and ratings.

A-2808

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

Unit at left is rated 14400 — 12 volts; unfused.

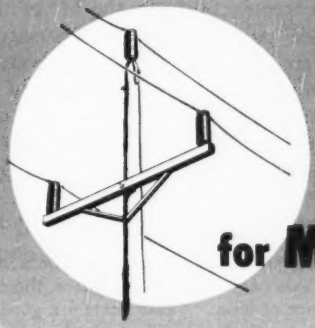
Rating of PD transformer at right is 2400 — 120 volts; unfused.

ALLIS-CHALMERS

Pioneers in Power and Electrical Equipment from Generation through Utilization

A-C ALLIS CHALMERS

Don't Let OLD STANDARDS HOLD BACK PERFORMANCE



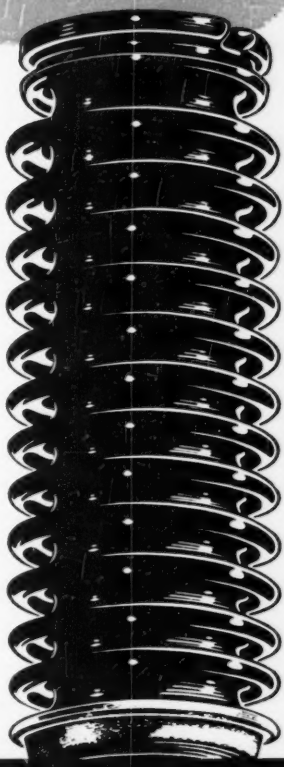
Now is the Time

to STANDARDIZE for MAXIMUM PERFORMANCE

IF you're one of the men who said, some eighteen years back: "Seems like a good idea—in theory" . . . well, sir, Lapp Line Posts have long since *proved* that they're the *best* idea . . . on hundreds of lines . . . for efficient performance.

- On installations which gave Lapp Line Posts their first trial on "trouble-spots": Lapp Line Post replacement rate is only 1% to 10% that of ordinary insulators *on the same lines.*
- 18 years of performance records prove . . . Flashover and mechanical attack which knock out ordinary insulators are absorbed by Lapp Line Post petticoats . . . body remains uncracked . . . insulator continues in fully effective service.
- Lapp Line Post Fog Type corrugation has eliminated cleaning from maintenance schedules—with full confidence of efficient performance.
- In every one of the hundreds of installations where performance records are kept on them, *lines on Lapp Line Posts have fewer outages, require fewer replacements and less maintenance than comparable lines on any other type of insulator.*

Proof that Lapp Line Posts give maximum performance . . . with maximum economy! It's a long time now since they were a "new-fangled idea." It's high time to consider whether you can any longer afford *not* to standardize on Lapp Line Posts for your own lines.



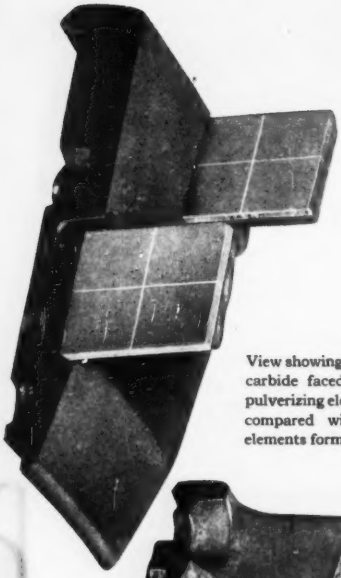
PERFORMANCE IS PROOF

Lapp INSULATORS

LAPP INSULATOR CO., INC. • LE ROY, N.Y., U. S. A.

Now RILEY Pulverizer

A great pulverizer development
Hardness near that of diamond



View showing tungsten carbide faced moving pulverizing elements as compared with alloy elements formerly used

Stationary tungsten carbide faced pulverizing elements as compared with former alloy elements

The use of tungsten carbide facings on Riley pulverizer parts adds tremendously to the life of the parts. Such parts when pulverizing sand to accelerate wear have outlasted six sets of alloy parts without showing any measurable signs of wear. Hardness of tungsten carbide approaches that of the diamond. Experiments and developments with the use of tungsten carbide pulverizer parts were started by Riley over ten years ago.

GREATLY REDUCED MAINTENANCE

While Riley pulverizers in actual use have been in operation with tungsten carbide parts for over two years, there is still no appreciable evidence of wear. These parts are good for many more years of service. Such long life results in greatly reduced maintenance costs placing the Riley pulverizer in a field by itself.

SUSTAINED FINENESS OF PULVERIZATION

Riley pulverizers equipped with tungsten carbide parts have shown no decrease in fineness of pulverization even after many times the amount of coal has been pulverized that formerly required replacement of parts. The fineness chart shows typical experience. As no wear is discernable to the carbide facings installed in these pulverizers, fineness will be maintained for many more thousands of tons of coal. No adjustments whatsoever are required to maintain fineness.

APPLICABLE TO EXISTING PULVERIZER

In keeping with Riley's policy of developing improvements which wherever possible can be applied to existing pulverizers, tungsten carbide parts can be installed in connection with most existing pulverizers. Many Riley pulverizer users have modernized their machines by applying this improvement. The following companies are a few of the many who have applied this improvement: Lynn Gas & Electric, Central Ohio Light & Power, Edison Electric Illuminating, Iowa-Illinois Gas & Electric, Potomac Electric Power, American Viscose, New York, New Haven & Hartford R.R., General Electric, Crocker-Burbank & Co.

TRADE MARK Rx REGISTERED

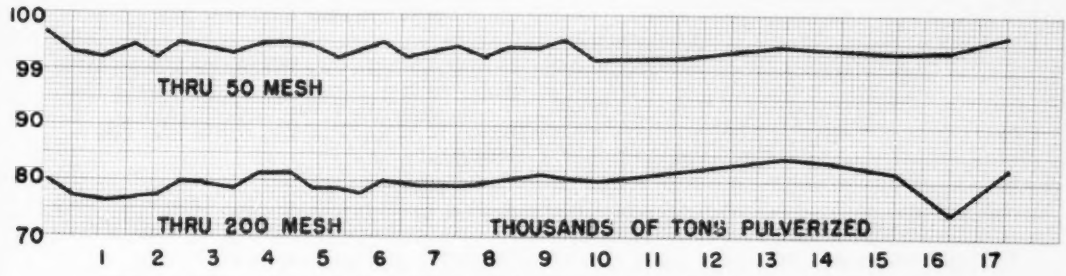
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Atlanta · New Orleans · Memphis · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

Parts with Tungsten Carbide Facings



Fineness against tons of coal pulverized. Fineness variations of any magnitude due to varying grindability.

Other operating advantages . . .

in addition to long life, low maintenance and sustained fineness of pulverization.

Flexibility—Wide Load Range

As change in coal feed gives instantaneous corresponding change in pulverized coal output—there is no lag—rapidly and widely fluctuating loads are efficiently and easily carried.

Ability to Carry Low Loads

With the combination of Riley pulverizers and burners, extremely low loads with stable ignition can be maintained. It is not unusual for load ranges of 10 to 1 or for loads under 5000 pounds of steam per hour to be carried at Riley installations.

High Primary Air Temperatures

There is no necessity of limiting primary air temperatures as a precaution against fire or explosion or because of lubricating problems. Expensive control equipment limiting primary air temperatures is not required.

Ability to Handle Wet Coals

With Riley pulverizers coal is pulverized in complete suspension, and not between two surfaces, affording the most effective drying effect from the hot air passing through the pulverizer.

Ease of Lighting

Because of small percentage of primary air, a rich and readily lighted mixture of air and coal is obtained which together with the uniform distribution with Riley burners makes lighting easy and gives stable flame at low loads.

Quiet, Vibrationless Operation

There is no comparison between Riley pulverizers and other makes insofar as quiet vibrationless operation is concerned. You hear nothing more than a motor hum.

Small Space Required—Minimum Foundations

Riley pulverizers require less space per unit of capacity. Massive deep foundations are not required due to their vibrationless quiet operation.

Explosion Proof

There has never been an explosion in a Riley pulverizer. The velocity of coal travel through the pulverizer is faster than the rate of flame propagation, eliminating the possibility of an explosion.

These Companies have installed Riley Pulverizer equipment

Northern Virginia Power Co.
Riverton Station

Iowa-Illinois Gas & Electric Co.
Davenport, Iowa

Carnegie Illinois Steel Corp.
Carrie Furnaces, Rankin, Pa.

Otter Tail Power Co.
Crookston, Minn.
Hoot Lake, Minn.

Pennsylvania Electric Co.
Williamsburg, Pa.

Carolina Power & Light Co.
Moncure, N. C.

Utah Power & Light Co.
Provo, Utah

Edison Electric Illuminating Co.
Boston, Mass.

Monsanto Chemical Co.
Everett, Mass.

West Penn Power Co.
Milesburg, Pa.

Southern Ind. Gas & Electric Co.
Evansville, Ind.

Kennecott Copper Co.
Chase Brass & Copper Div.
Waterville, Conn.

Riegel Textile Corp.
Ware Shoals, S. C.

Bird & Sons
E. Walpole, Mass.

Armstrong Cork Co.
Beaver Falls, Pa.

Calumet & Hecla Consol. Copper Co.
Calumet, Mich.

Hooker Electro Chemical Co.
Niagara Falls, N. Y.

Container Corp. of America
Manayunk, Philadelphia, Pa.

Celanese Corp. of America
Narrows, Va.

Columbia Records, Inc.
Bridgeport, Conn.

Crocker-Burbank & Co.
Fitchburg, Mass.

Savannah Sugar Refineries
Savannah, Ga.

C. H. Masland & Sons
Carlisle, Pa.

Horlick's Corporation
Milwaukee, Wis.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

REDUCE ASSEMBLY TIME with Inmanco

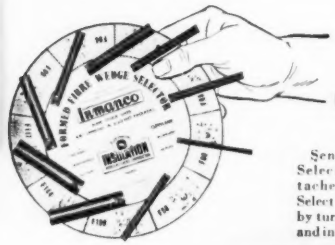
FORMED FIBRE WEDGES

Try slipping an Inmanco Formed Fibre Wedge into the slot . . . notice how smoothly it glides in. That's because Inmanco Wedges have superior moisture resistance to keep the ends from spreading and prevent other distortion.

Now, try breaking off the projecting end . . . see how *cleanly* it snaps off at the end of the slot. no time is wasted in cutting the wedge to length. These easy insertion and clean break-off features save assembly time, reduce your labor costs.

Inmanco Formed Fibre Wedges are carried in stock in nine standard "U"-shaped sizes to meet practically all wedging applications. They are supplied in standard 48-in. lengths, in moistureproof bundles of 250 feet. Special sizes and lengths can be made to meet your individual requirements. Start saving assembly time, now, with Inmanco Formed Fibre Wedges. Write, today, for full information and samples, telling us the approximate sizes you use.

QUICKEST OF ALL FIBRE WEDGES TO INSTALL

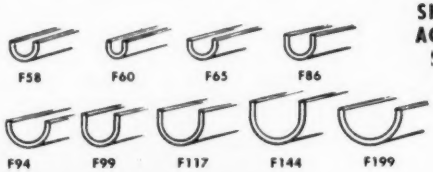


FREE
FIBRE WEDGE SELECTOR

Send for this unique Selector Card with attached wedge samples. Select the proper size just by turning out each wedge and inserting it in the slot.

NINE STANDARD "U"-SHAPED STOCK SIZES

SHOWN ACTUAL SIZE



INMANCO PRODUCTS ARE MANUFACTURED EXCLUSIVELY BY

INSULATION MANUFACTURERS CORPORATION

565 W. WASHINGTON BLVD., CHICAGO 6

WHERE TO GET INMANCO FORMED FIBRE WEDGES

CHICAGO, ILL.
Complete-Reading Elec. Co., Inc.
Insulation Manufacturers Corp.

CLEVELAND, OHIO
Insulation Manufacturers Corp.

DAYTON, OHIO
Insulation Manufacturers Corp.

DENVER, COLO.
Electrical Specialty Co.

DETROIT, MICH.
H. R. Brethen
Insulation Manufacturers Corp.

FRESNO, CALIF.
Western Fiberglas Supply, Ltd.

LOS ANGELES, CALIF.
Electrical Specialty Co.
Tri-State Supply Corp.
Western Fiberglas Supply, Ltd.

MILWAUKEE, WIS.
Insulation Manufacturers Corp.

MINNEAPOLIS, MINN.
H. A. Holden, Inc.
Insulation Manufacturers Corp.

MOBILE, ALA.
Russell Electric Co., Inc.

NEWARK, N. J.
Robert McKeown Co.

OAKLAND, CALIF.
Western Fiberglas Supply, Ltd.

PEORIA, ILL.
Insulation Manufacturers Corp.
W. C. Johnson

PORTLAND, ORE.
Electrical Specialty Co.

SACRAMENTO, CALIF.
Western Fiberglas Supply, Ltd.

SAN FRANCISCO, CALIF.
Electrical Specialty Co.
Tri-State Supply Corp.
Western Fiberglas Supply, Ltd.

SEATTLE, WASH.
Electrical Specialty Co.
Tri-State Supply Corp.

No "SQUATTERS" Allowed

INSIDE YOUR DIESEL CRANKCASE!

NEWEST GARGOYLE OILS

keep incomplete combustion particles and oxidation products on the move...bearings and oil passageways free of sludge.

★ ★

For CONTINUOUS POWER—Rely on the BEST!

Here's a spot inside high-output Diesels where you're likely to have unwelcome settlers. That oil shown draining down from the cylinders brings with it contaminating materials that tend to settle on the crankcase surfaces and oil passageways. Now Socony-Vacuum has licked this problem. The latest Gargoyle Oils for Diesels are designed to keep these materials dispersed, so they can't collect on vital parts or clog passageways. Your crankcase—as well as your cylinder walls and pistons—*stay clean.*

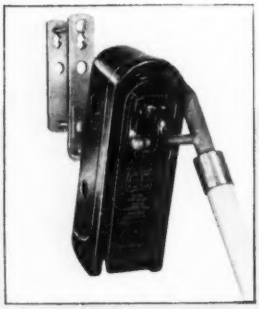
SOCONY-VACUUM

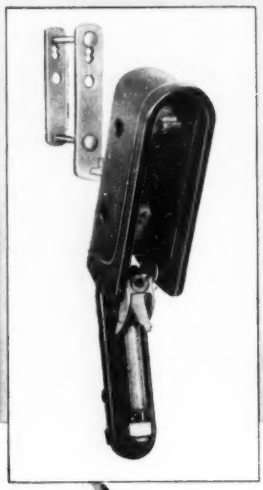
GARGOYLE Lubricants

SOCONY-VACUUM OIL CO., INC.
and Affiliates, MAGNOLIA PETROLEUM CO.,
GENERAL PETROLEUM CORPORATION

Rely on **SOCONY-VACUUM**
Correct Lubrication

Now...





SAFER AND SIMPLER TO OPERATE
• • •
COMPLETELY HOOKSTICK OPERATED

The type PE-33 can be operated by a bayonet-type or clamp-type hookstick to open, close, remove and replace door without being touched by hand. The SS bayonet-type will do it . . . QUICKLY and SAFELY! The door can be opened and closed by ANY hookstick, and removed and replaced by hand. It is completely dead when open. These features make the SS Type PE-33 the safest cutout available.

High pressure is maintained on silvered contact surfaces by phosphor bronze back up springs. Terminal screws are rugged to withstand repeated installations without deforming.

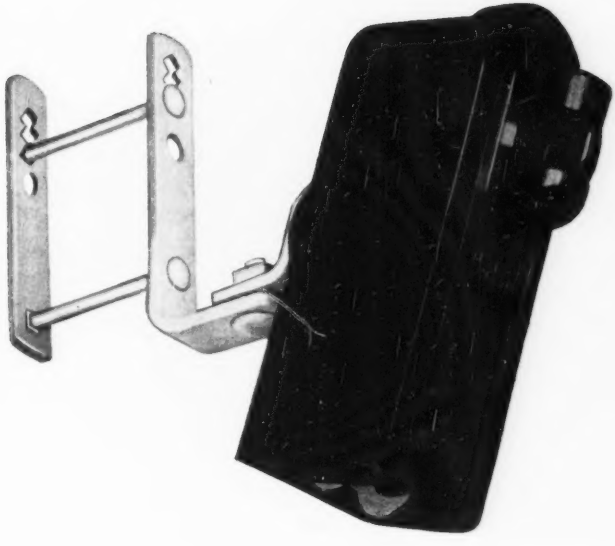
The mounting bracket is designed to meet NEMA and EEI standards for universal use with cutouts and lightning arresters.

Immediately available through your local jobber in the following ratings:
5 kv 50 amp
7.5 kv 50 amp

The new type PE-33 porcelain-enclosed cutout is a worthy companion to Southern States' famous open type 33 dropout cutout. The type PE-33 has been designed for full dropout operation. Ruggedly built . . . Easily re-fused. This cutout can be converted to 100 amp disconnecting switch by substitution of solid blade door assembly.

the Type PE-33

Southern States'
Porcelain-Enclosed
Dropout Distribution Cutout



Southern States Equipment Corp.

HAMPTON GEORGIA

Representatives in:

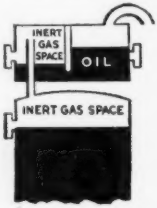
BIRMINGHAM, ALA.	CHICAGO, ILL.	KANSAS CITY, MO.	DALLAS, TEX.
LOS ANGELES, CALIF.	EVANSVILLE, IND.	ST. LOUIS, MO.	EL PASO, TEX.
SAN FRANCISCO, CALIF.	VALPARAISO, IND.	NEW YORK, N. Y.	HOUSTON, TEX.
DENVER, COLO.	LOUISVILLE, KY.	CHARLOTTE, N. C.	LUBBOCK, TEX.
WASHINGTON, D. C.	NEW ORLEANS, LA.	PHILADELPHIA, PA.	SALT LAKE CITY, UTAH
JACKSONVILLE, FLA.	SHREVEPORT, LA.	CHARLESTON, S. C.	SEATTLE, WASH.
MIAMI, FLA.	BOSTON, MASS.	KNOXVILLE, TENN.	MILWAUKEE, WISC.
ATLANTA, GA.	JACKSON, MICH.	MEMPHIS, TENN.	

Four Reasons for

TWO WAYS to increase the return on your transformer investment are to reduce rate of depreciation and trim maintenance costs. These objectives are accomplished in Allis-Chalmers power transformers with features like those below. These four features, when added together over the life span of the transformer, can make a *big difference* in your power transformer operating costs. Here's why:

1 SIMPLE, POSITIVE OIL PROTECTION

Oil-Sealed Inert Gas oil protection, introduced by Allis-Chalmers, operates practically without attention. No replenishment of gas containers necessary. Low pressure system (not over 1 lb per sq in.) extends gasket life. Effective oxygen, moisture seal eliminates sludge and acid formation in transformer oil.



2 LONGER GASKET LIFE

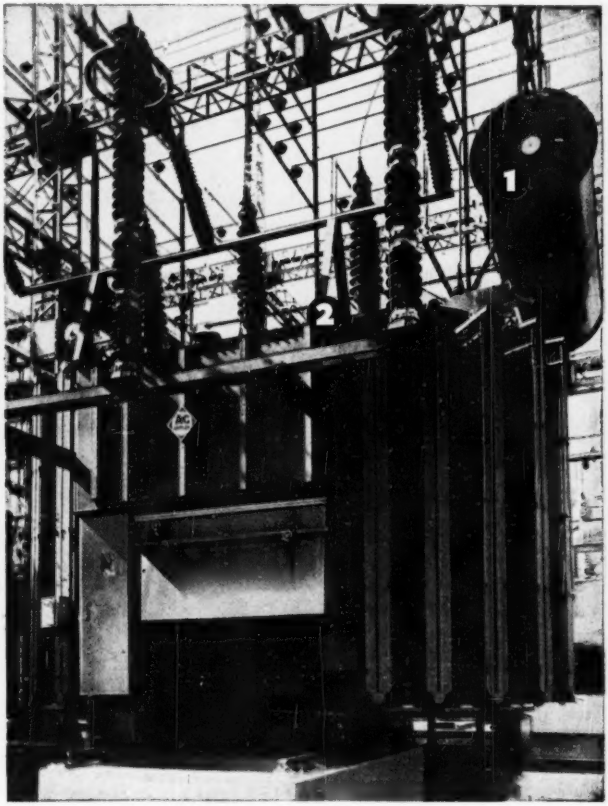
A seemingly small detail like gasketed seals quickly assumes great importance when they fail to function properly and costly maintenance is required. On Allis-Chalmers power transformers, maximum gasket life and effectiveness are *assured* through metal-to-metal controlled gasket compression.

3 LOW UPKEEP FOR RADIATORS

Radiators are rigidly braced, grooved for added strength. Surface is protected with bonderized coating, followed by two coats of high quality outdoor paint. When repainting is desired, the job is made easier because radiators have staggered cooling fins.

4 SIDE OPERATED TAP CHANGER

It's easier, and takes less time to change taps with Allis-Chalmers No Load Tap changer because of its side-of-tank location. There's no danger of coming in contact with high voltage overhead system. Tap positions are easily read from ground level.



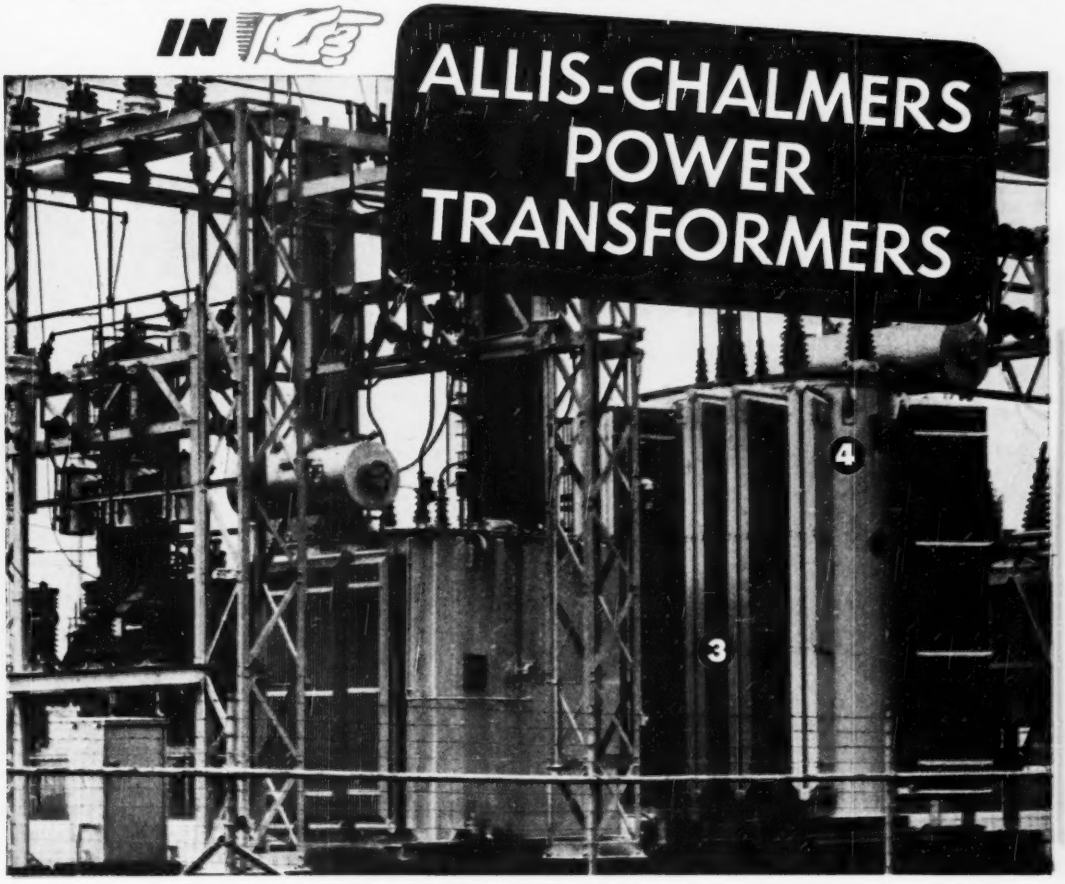
INTERCONNECTING three systems at a large Indiana substation, this transformer is rated 24,000/30,000 kva, 3 phase, 138-69-34.5 kv. Since its installation in 1945, two duplicate units have been ordered. Typical Allis-Chalmers low-maintenance construction includes the four features at left.

ALLIS

Pioneers in Power

Low Maintenance

IN



ALLIS-CHALMERS TRANSFORMER and regulator work together, serving an important load in Louisiana oil producing area. Transformer is equipped with four 2½% full capacity taps below normal — regulator supplies ±10% regulation in ⅝% steps.

Again, *Oil-Sealed* Inert Gas Protection and other features at left are a part of the Allis-Chalmers low-maintenance design.

For details on Allis-Chalmers quality transformer construction, contact your nearby A-C sales representative. Or write direct.

A-2852

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

Oil-Sealed is an Allis-Chalmers trademark.

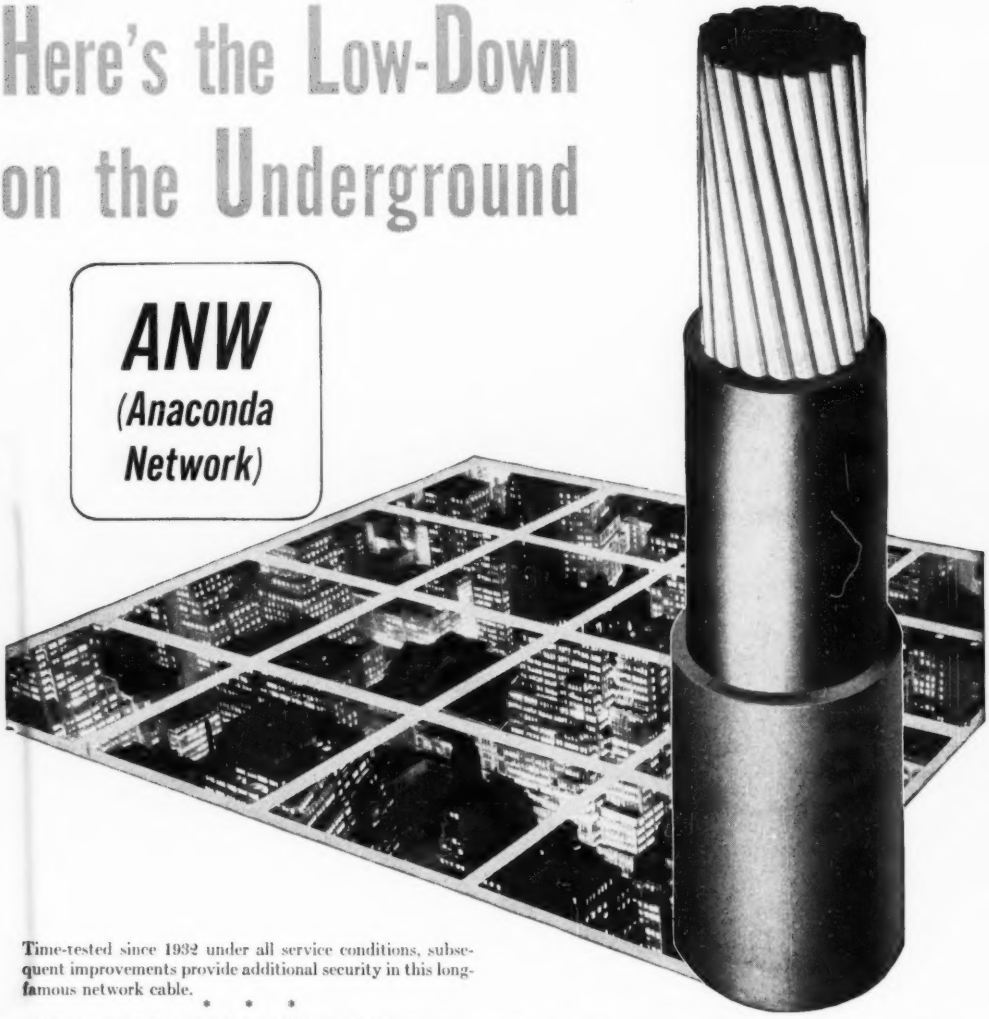
CHALMERS

A-C ALLIS-CHALMERS

and Electrical Equipment from Generation through Utilization

Here's the Low-Down on the Underground

ANW
(Anaconda Network)



Time-tested since 1932 under all service conditions, subsequent improvements provide additional security in this long-famous network cable.

* * *

Tough, easily handled, Type ANW-insulated, neoprene-jacketed cable incorporates six important advantages . . . important to you for underground duct installation.

1. Better heat and flame resistance—protected by the same neoprene jacket as Anaconda mining cables which must and do meet the severe flame test of the U.S. Bureau of Mines.

2. Higher resistance to duct acids and alkalies—years of experience with Type ANW insulation with only a braid covering showed it to be highly resistant to oils, acids and alkalies encountered in soil and sewage waters. NOW it has the additional protection of the neoprene jacket which itself has shown by test and experience, excellent resistance to these agents of destruction.

3. Higher operating temperature—now 75 C copper temperature, continuous duty.

4. Superior aging—Type ANW insulation has demonstrated year after year . . . and now even better . . . long-aging characteristics under severe oxygen bomb and air bomb tests.

5. Low Moisture absorption—Type ANW insulation has always had low moisture absorption . . . far less than is detrimental to safe operation.

6. More easily handled—passes 180 degree cold-bend test at 0° C without damage to jacket. Cable is lighter, easier to pull. No lead to fuse, insulation and jacket do not support combustion.

49444

ANACONDA from mine to consumer

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4, N. Y.

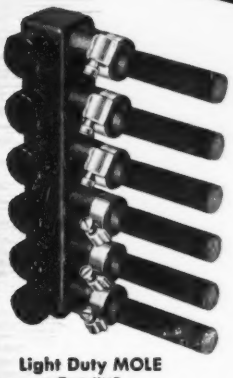
UNDERGROUND

Burndy underground connectors have been time-tested for over a decade in actual service. Preferred because of their rapid installation, flexibility, and low cost. All pre-insulated to eliminate taping wherever possible. Ask for the Mole Line Catalog, or engineering assistance. BURNDY Engineering Company, New York 54, N. Y.
WESTERN BRANCH: Vernon 11, California.
CANADA: Burndy Canada Ltd., Toronto 8.

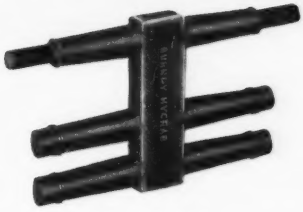
MOLE
Type ZM

25 YEARS OF SERVICE

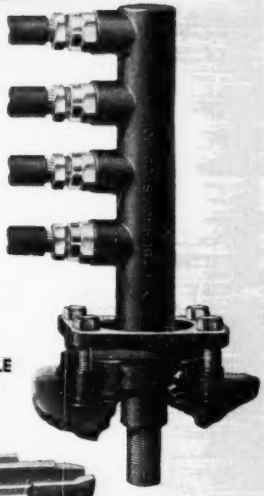
Connect with BURNDY



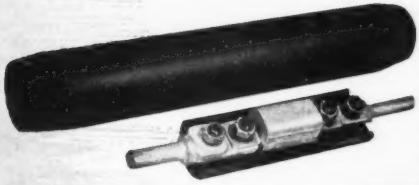
Light Duty MOLE
Type KME



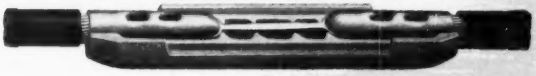
HYCRAB
Type YM



STUD MOLE
Type ZMLD

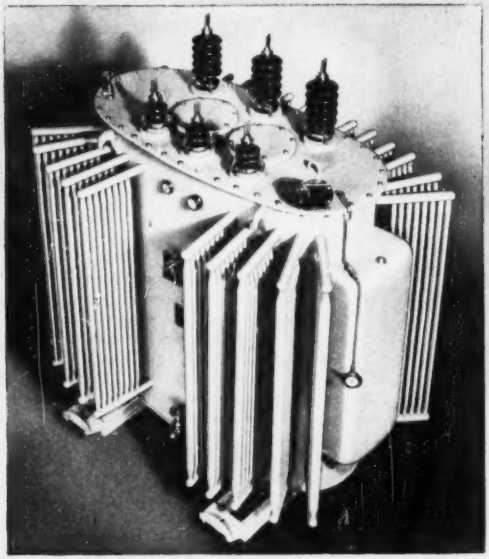


Replaceable Link MOLIMITER
Type LYM



LIMITER
Type YFS

The WHO WHAT WHY WHEN and WHERE



on how you can SAVE UP TO 8% by specifying

PENNSYLVANIA STANDARD PARTS POWER TRANSFORMERS

? WHO Can Use Pennsylvania Standard Parts Power Transformers?

Practically all utilities and industrials can use Pennsylvania Standard Parts Power Transformers because the electrical ratings and accessories are in accordance with A.S.A. and NEMA Standards. To meet a wider range of system requirements, variations are permitted both in accessories and in electrical characteristics. For example: Any accepted method of oil preservation can be had with Standard Parts transformers.

? WHAT Are Pennsylvania Standard Parts Power Transformers?

They are single or three phase Power Transformers, now manufactured in sizes up to 10,000 Kva and up to 69 Kv. Transformers are "Standard" when they conform to standard voltage ratings and are equipped with standard accessories in standard locations. For such transformers a full discount of up to 8% is applied. When voltages are other than standard, but within a certain voltage rating, slightly lower discounts are applied.

? WHY Do Standard Parts Power Transformers Sell for Less?

Because quantity production methods of manufacturing, coupled with the use of standard designs and standard parts, shorten engineering and production time which, in turn, reduces the price of the transformer by as much as 8%.

? WHEN Can Deliveries Be Made on Standard Parts Power Transformers?

On some ratings, deliveries can be made 3 or 4 weeks from the time an order is entered. On other larger ratings, deliveries can be made in a comparatively short time.

? WHERE Can More Information on Standard Parts Power Transformers Be Obtained?

By writing to Pennsylvania Transformer Company, Box 330, Canonsburg, Pennsylvania and asking for a copy of Catalog No. 1492.

Pennsylvania
TRANSFORMER COMPANY
Canonsburg, Pa.
Greater Pittsburgh District

KEARNEY
TRIPOMATIC
HEAVY DUTY
FUSE CUTOUT

For High Interrupting Capacity on To-day's Power Lines

FEATURES:

1. **Reinforced housing of highest quality wet-process glazed porcelain and the non-warping door of molded bakelite provide a heat and shock-resisting unit.**
2. **Silver-plated upper contact serves as a latch to hold the door in the closed position. The resilient corrosion resistant spring absorbs the impacts of high interrupting duty.**
3. **Stirrup latch on the non-indicating cutout prevents opening of door and insures against damage from cable expulsion or drawn-out arcs on extreme short-circuits.**
4. **Cartridge head with silver-plated contact studs assures excellent conductivity through four point pressure contacts with upper spring.**

IN THE DAYS when heavily overloaded circuits were still the exception and not the rule, the Kearney Heavy Duty Trip-O-Matic non-indicating cutout was designed to meet the requirements of a large power company whose over-taxed circuits demanded heavy-duty protection. This cutout has served the company dependably with maximum protection for over nine years.

And now when overloaded circuits are an everyday problem and with the outlook for more and more power demands in the future, the Kearney HD cutout is available for all power companies. Its nine-year in-service record of electrical and mechanical dependability in protecting heavily loaded circuits subject to high short-circuit surges is your assurance of dependable performance.

Illustration shows the Kearney Trip-O-Matic Heavy Duty Fuse Cutout, Catalog No. 12143-10, 50 amperes, 5000 volts. Interrupting current rating 5000 amperes at 5000 volts; 8000 amperes at 2500 volts.

For additional information on Kearney HD cutouts, write for Catalog Sheet 2-11.

JAMES R. KEARNEY CORPORATION
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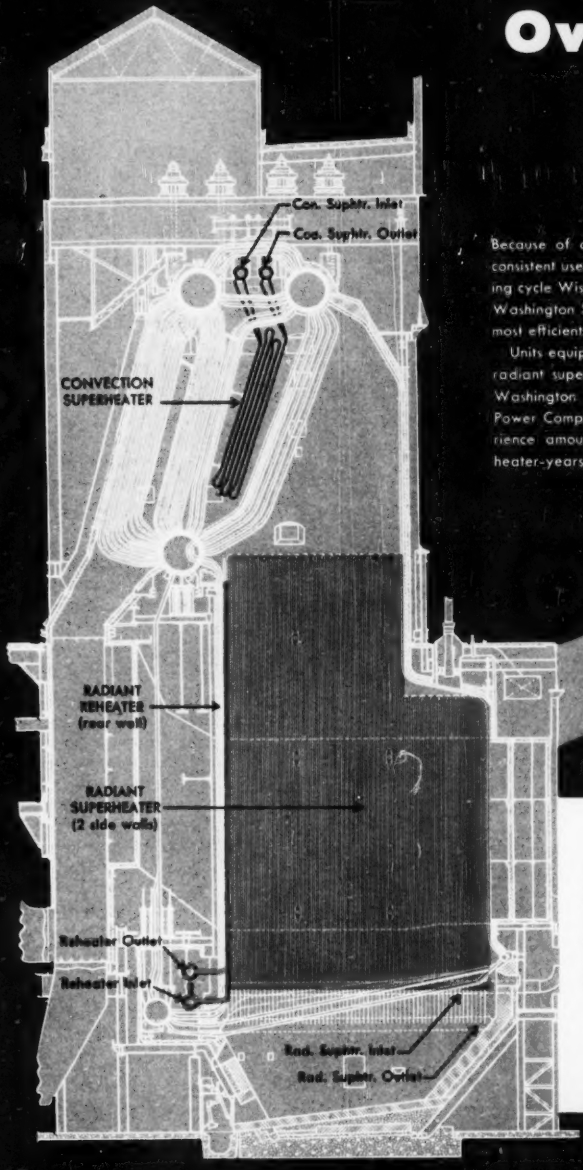
Always Specify JAMES R. KEARNEY CORPORATION ST. LOUIS, MO. *for the Job . . .*

Better Construction — *SAFER* Maintenance

Over 500

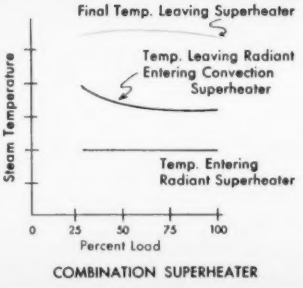


Because of a farsighted program involving the consistent use of a high temperature reSuperheating cycle Wisconsin Electric Power Company's Port Washington Station is today one of the country's most efficient power plants.

Units equipped with FW radiant reheaters and radiant superheaters at both Lakeside and Port Washington Stations of the Wisconsin Electric Power Company show a total of successful experience amounting to over 500 "radiant superheater-years."

1949

FOSTER



COMBINATION SUPERHEATER

Fig. 1
Note flat final steam temperature

FOSTER WHEELER CORPORATION

"radiant superheater-years"

in one utility alone*

*See TRANSACTIONS of the ASME, August, 1949, page 738.

1948 1943 1935 1929

WHEELER RADIANT REHEATERS and SUPERHEATERS

Foster Wheeler Reheat and Radiant Superheaters. Foster Wheeler experience in the design and operation of radiant and convection surface dates from 1902 with the introduction of commercial use of superheated steam into the United States. ***A wider selection of fuels*** for resuperheating units may be obtained by using superheaters and reheaters which include FW radiant heat absorbing sections. This is in sharp contrast to the all convection type which will provide a wide range of steam temperature control at the risk of considerable slagging in both furnace and hotter convection zones. This also applies in the case of non-reheat units with wide control ranges. Performance data on units equipped with FW radiant surfaces for superheating and resuperheating at the Lakeside and Port Washington Stations of the Wisconsin Electric Power Company also testify to such advantages as ***a very high operating reliability*** and ***the compensating effect in temperature characteristics*** as against exclusively convection arrangements with steep load temperature curves (see figures 1 and 2). The fact that 35.6% of the total BTU duty on Unit No. 5 at Port Washington will be performed by the superheater and reheater well illustrates the magnitude of this function of a modern steam generator.

Availability at Port Washington is 95%. To date, four units incorporating FW radiant reheating and radiant and convection superheaters have been installed in the Port Washington Station. The fourth unit was started in August 1949 and a fifth is in fabrication. The combined availability of the first three operating units, the initial one of which was installed in 1936, is 95% for a total of 147,235 hours of service as of December 26th, 1948.

For further information, write for Paper No. 48-A-120

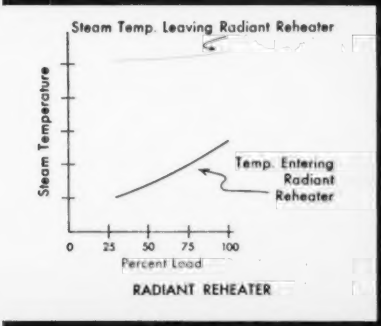


Fig. 2
characteristics over wide load ranges

165 BROADWAY, NEW YORK 6, N.Y. FOSTER WHEELER

Let's Look at the CURRENT PATH

Thruout the entire range, from 400 to 5000 amperes and from 7.5 to 230-kv., the current path of the "MK-40" is designed with a minimum number of current interchange surfaces. High pressure silver-to-copper contacts are used at both ends of the tubular floating blade—the simple and logical way to eliminate flexible shunts. All parts are in plain view for visual inspection.

Single Pole "MK-40" Unit, 1200-amp., 34.5-kv.

ONLY THE "MK-40" HAS ALL THESE FEATURES

1. Both ends of the blade have the same type of reliable high pressure silver-to-copper contacts backed by sturdy beryllium alloy springs. Current carrying function of the contacts is independent of the pressure applying members.

2. There are no other springs or moving contact surfaces; no small parts.

3. The number of current interchange surfaces is reduced to an absolute minimum. Hinge pins do not carry current.

4. All of the few parts in the current path are in plain view for visual inspection.

Plus of course—smooth ease of operation with blade under full control at all times; locking in both opened or closed positions.

WHEN YOU WANT THE BEST IN HIGH VOLTAGE SWITCHES SPECIFY THE "MK-40"

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ANOTHER *Solo*

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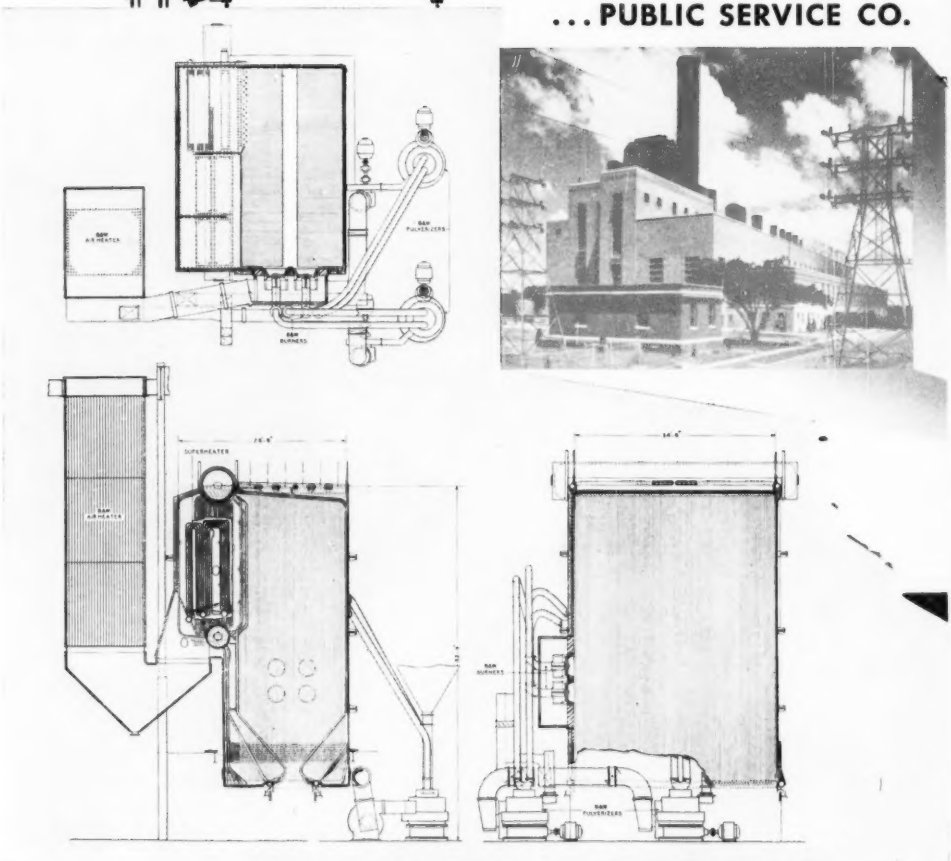


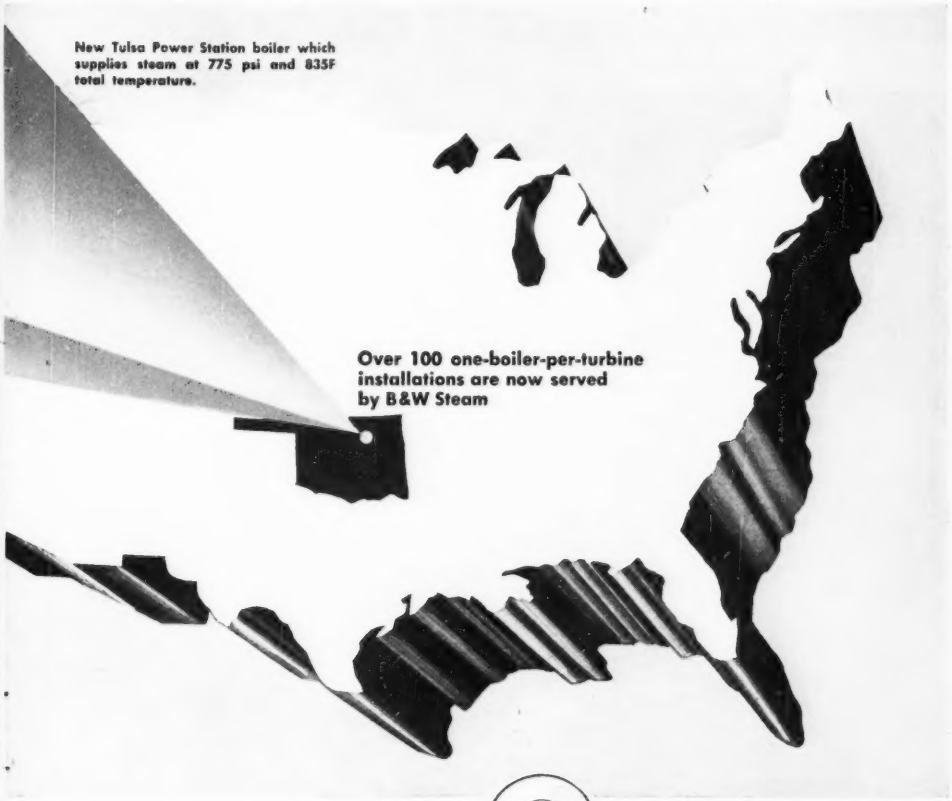
Steam for a new 30,000 Kw. turbo-generator at Public Service Co. of Oklahoma's Tulsa Power Station is supplied by a single B&W Integral-Furnace Boiler, Type FH. Details of this hopper-bottom unit are shown above.

Normally gas-fired, the boiler is arranged for coal-firing in winter by two B&W pulverizers and also has B&W oil-burners to provide another standby fuel. Sargent and Lundy, Chicago, were the consulting engineers.

More and more power companies are finding the B&W Integral-Furnace boiler,

Performance FOR B&W STEAM

OF OKLAHOMA—TULSA POWER STATION


New Tulsa Power Station boiler which supplies steam at 775 psi and 835F total temperature.
Over 100 one-boiler-per-turbine installations are now served by B&W Steam

Type FH, the best buy for steam requirements up to 350,000 lb. per hr., and for outdoor as well as conventional installations.

Get Bulletin G-38 describing this popular unit. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

B&W

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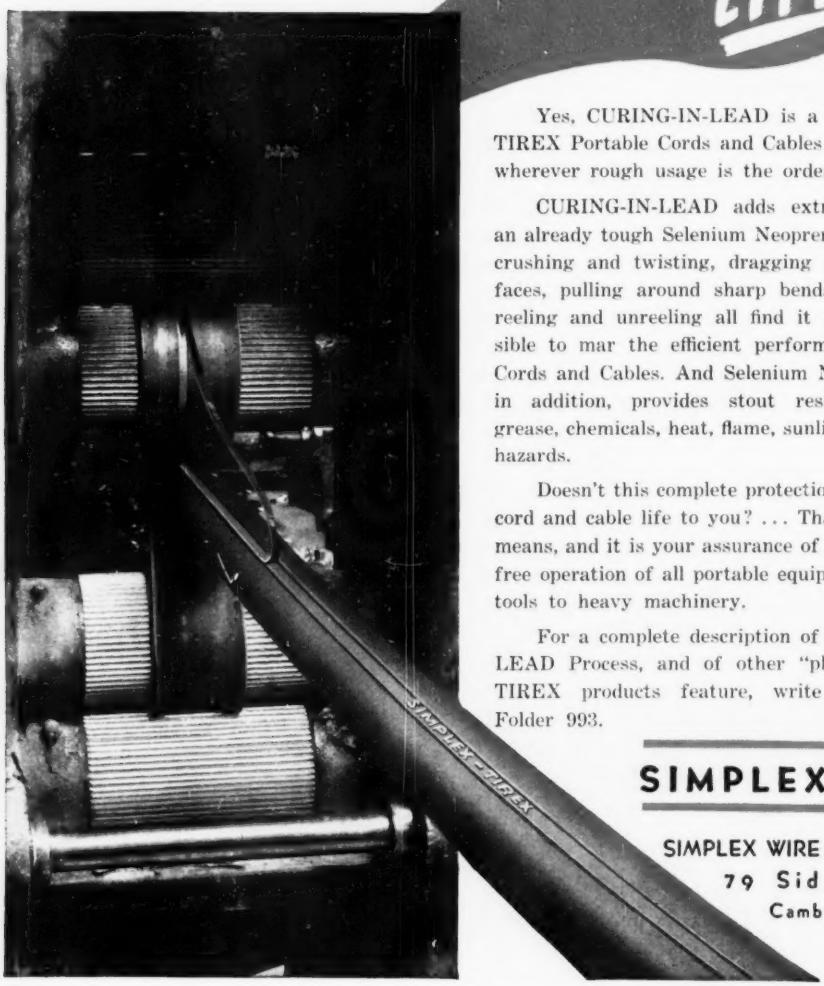
G-444

Adding Years to TIREX CORD & CABLE LIFE



Yes, CURING-IN-LEAD is a big reason why TIREX Portable Cords and Cables stand up longer wherever rough usage is the order of the day.

CURING-IN-LEAD adds extra toughness to an already tough Selenium Neoprene jacket so that crushing and twisting, dragging over rough surfaces, pulling around sharp bends, and continual reeling and unreeling all find it well-nigh impossible to mar the efficient performance of TIREX Cords and Cables. And Selenium Neoprene Armor, in addition, provides stout resistance to oils, grease, chemicals, heat, flame, sunlight and weather hazards.

Doesn't this complete protection suggest longer cord and cable life to you? . . . That's just what it means, and it is your assurance of low-cost trouble-free operation of all portable equipment from hand tools to heavy machinery.

For a complete description of the CURED-IN-LEAD Process, and of other "plus" values that TIREX products feature, write us today for Folder 993.

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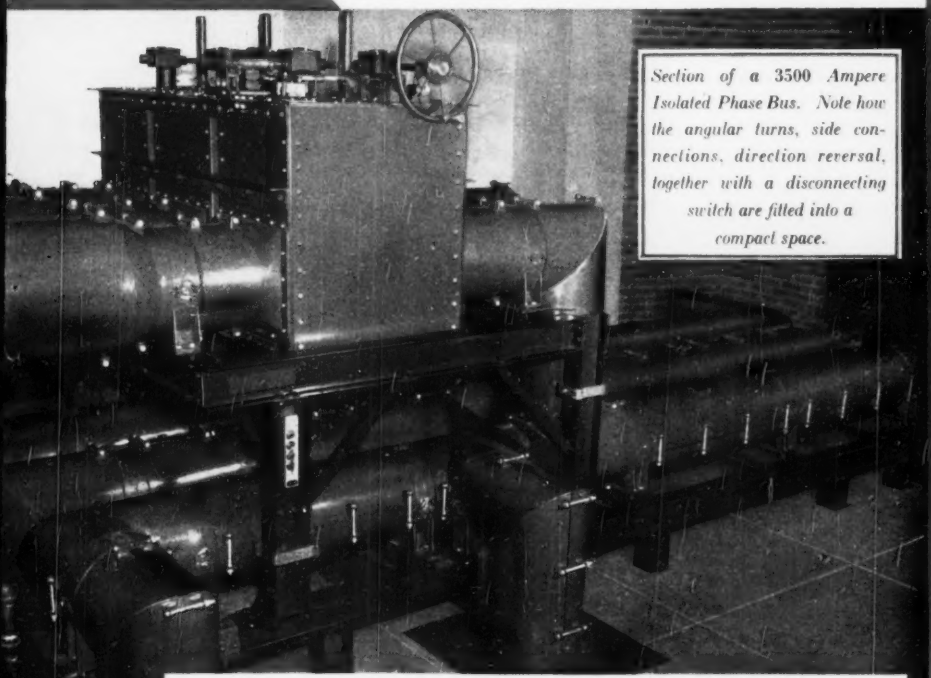
R&IE

ISOLATED PHASE, METAL ENCLOSED BUS STRUCTURES PROVIDE—

- highly reliable service
- reduction in maintenance
- complete factory fabrication
- all insulators in compression
- flexibility of arrangement
- extremely compact installation
- lower installation costs
- neat, trim appearance

CHECK the FACTS

Check all these advantages of isolated phase, metal enclosed bus structures against cable runs or cell structures. Then call in an R&IE engineer who will gladly discuss R&IE equipment for your installation.



Section of a 3500 Ampere Isolated Phase Bus. Note how the angular turns, side connections, direction reversal, together with a disconnecting switch are fitted into a compact space.

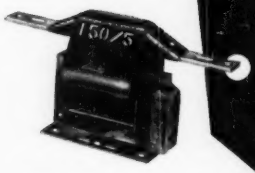
RAILWAY and INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.
AFFILIATED WITH THE I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.
IN CANADA—EASTERN POWER DEVICES LIMITED, TORONTO

The Check List

- CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- HORN GAP SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- DISTRIBUTION EQUIPMENT
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SWITCHING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

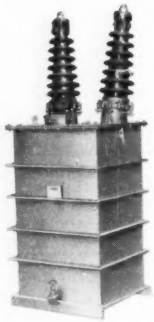
UPTEGRAFF

transformers



CURRENT—Uptegraff Type CR Indoor Current Transformer. Stocks available for immediate shipments.

SPECIALTY—Specialty Transformers are built for cabinet or indoor service. Sizes: 0.1 to 10 KVA. Type E completely enclosed unit shown.



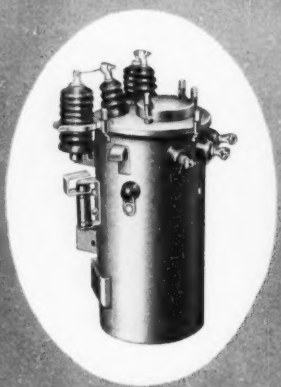
POTENTIAL—Uptegraff Potential Transformers are made in sizes up to 69,000 volts.

for every class of service

The dependability and economy of Uptegraff Transformers is proven by their service in installations of all types—power, distribution, instrument and specialty.

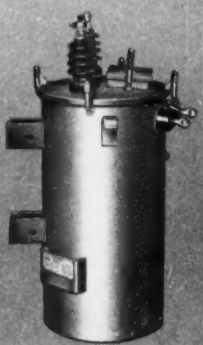
Uptegraff power transformers are made in sizes up to 10,000 KVA, 69 KV, for utility and industrial plant service, indoors or outdoors. Distribution transformers are made in liquid and air-cooled types, in sizes from 3 to 500 KVA. Specialty transformers include air-cooled and compound-filled types, specially designed and built to meet individual customer's requirements. A complete series of instrument and potential transformers rounds out the Uptegraff line.

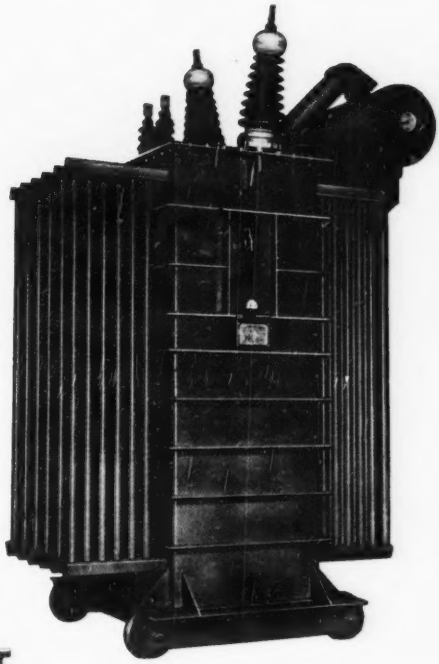
Quality construction and sound engineering designs assure the efficient, dependable performance of Uptegraff Transformers. We are prepared to give prompt service on units of standard or special design and construction.



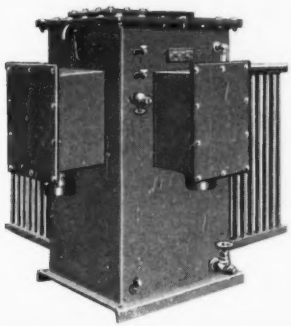
DISTRIBUTION

Distribution Transformers for pole mounting are made in all required sizes and ratings. Cover or pocket mounted high-voltage bushings as desired. Completely self-protecting type shown at left.





DISTRIBUTION—Large Uptegraff Distribution Transformers (below) are furnished for either outdoor or indoor service. Sizes, up to 69 KV Class.



POWER—Uptegraff Power Transformers are made in sizes to 10,000 KVA, 69 KV, for indoor or outdoor service. Oil or Askarel filled, sealed tank construction up to and including 2,000 KVA sizes. Structurally strong, electrically efficient, thoroughly dependable.

DRY TYPE—A complete line of Dry Type Distribution Transformers is offered by Uptegraff. Made with Class B insulation, in standard or special designs. Type DBT is shown here.

R. E. Uptegraff Manufacturing Co.

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Completely NEW!

IN DESIGN AND PERFORMANCE

BETTER
than anything you have ever seen or tried before.

The answer to John Lineman's Prayer.

Perfectly aligned, tie assembled zinc thimble—radio treed pin hole with Type "N" Glaze
DATED! A permanent service record. And something new in contours—missle and moisture sledding—radio treed glaze at all assembly points
1⅝" wire groove. ½" radius tie wire grooves—WOW!

A Complete Line to take care of Every Transmission Pintype Need.
(NEMA Standard)

The most radical departure from conventional insulator design in decades. Many designs were tried and tested. The final design is presented here. Utility Engineers, linemen and management will sing praises over the performance of these insulators for years to come. Write for folder describing the complete new line of Transmission Pintypes.

Porcelain Products, Inc.

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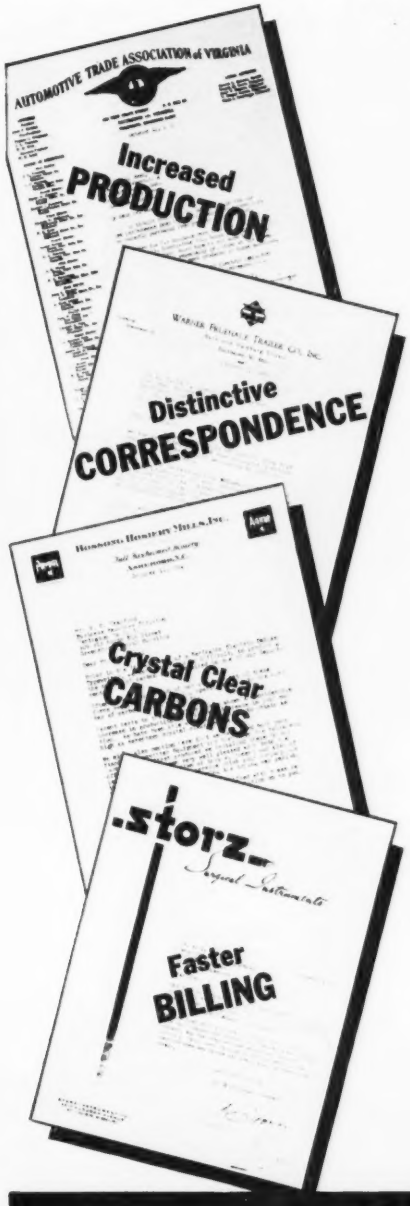
How the Remington Electric Deluxe



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Saves Money

Solves Typing Problems

Here's what satisfied customers say:

"We cut more than 4500 stencils and we are especially gratified at the speed and the quality of the work produced by these machines. We estimate that with the use of Remington Electric Typewriters our production has increased 50%."

"—I like the appearance of our letters with your new Remington Rand "100" Type; and find it much easier to read . . ."

"—Recent tests in this department have shown a considerable increase in production . . . we have been able with this machine to obtain as high as 17 crystal clear copies."

"—We find that with this new equipment our billing is done much faster, the output has increased about 30%, and the invoices are neater and cleaner looking."

● The superb Remington Electric Deluxe can accomplish these advantages and at the same time *increase* typing production for *your* business. The fast, easy, electric action allows fingers to fly over the keyboard turning out *more* work, *better* work in *less* time and with *less* effort. So why not start saving today, the *electric* way. For full information on how the Remington Electric Deluxe speeds work, saves money and solves typing problems, send for a FREE copy of "New Office Profits Through Electricity". Address requests to Remington Rand, Department T-53, 315 Fourth Avenue, New York 10, N. Y.

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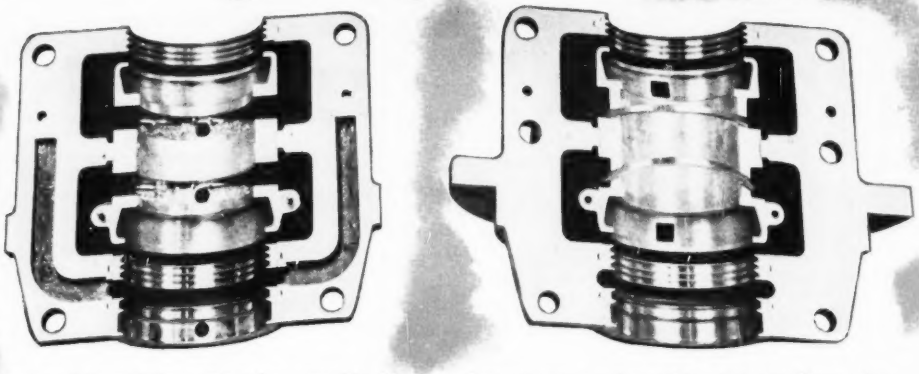
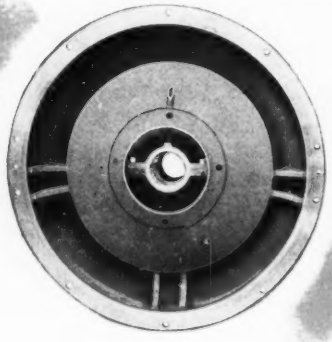
THE FIRST NAME IN TYPEWRITERS

Oil vapors get a one-way



Upper and lower halves of bearing assembly. Note cored passageways and matching holes in flanges for escape of vapor-laden air.

Bronze bearing shell with thin babbitt liner securely bonded, has adequate bearing surface for carrying load in bottom half of shell, with relieved bearing surface in top half to reduce bearing loss. Pressure-oil lubricated bearings with oil rings for start-up and emergency service are standard on motors of 1000 hp and larger. Oil slingers on shaft throw oil into recessed pockets in end of bearing to prevent oil flow along shaft to labyrinth shaft seals at each end.



Note reinforcing ribs on the inside of bracket as well as reinforcing ribs on outside bottom of bracket . . . Air directing baffle is welded to inside of bracket. Note pressure tube which carries air under pressure into the bearing housing for sealing against oil vapor leakage . . . Bracket fit on stator frame is machined concentric with core. Matching rabbet fit on bracket is jig machined to insure and maintain close air gaps. Inspection holes for checking air gap may be observed through air baffle.

Elliott **FABRI-STEEL 2-POLE MOTORS** have established a new milestone in big motor development with their all-steel construction plus a design which insures new performance, longer life, less maintenance. Two-pole induction motors are built in ratings from 350 to 4000 hp; drip-proof, splash-proof, enclosed separately (forced) ventilated, enclosed self-(pipe or base) ventilated, enclosed self-ventilated with built-in coolers. *Write for Bulletin PB7000-1.*

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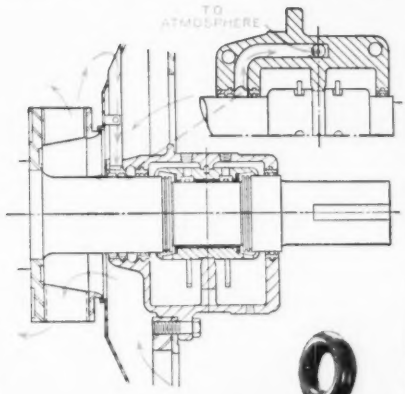
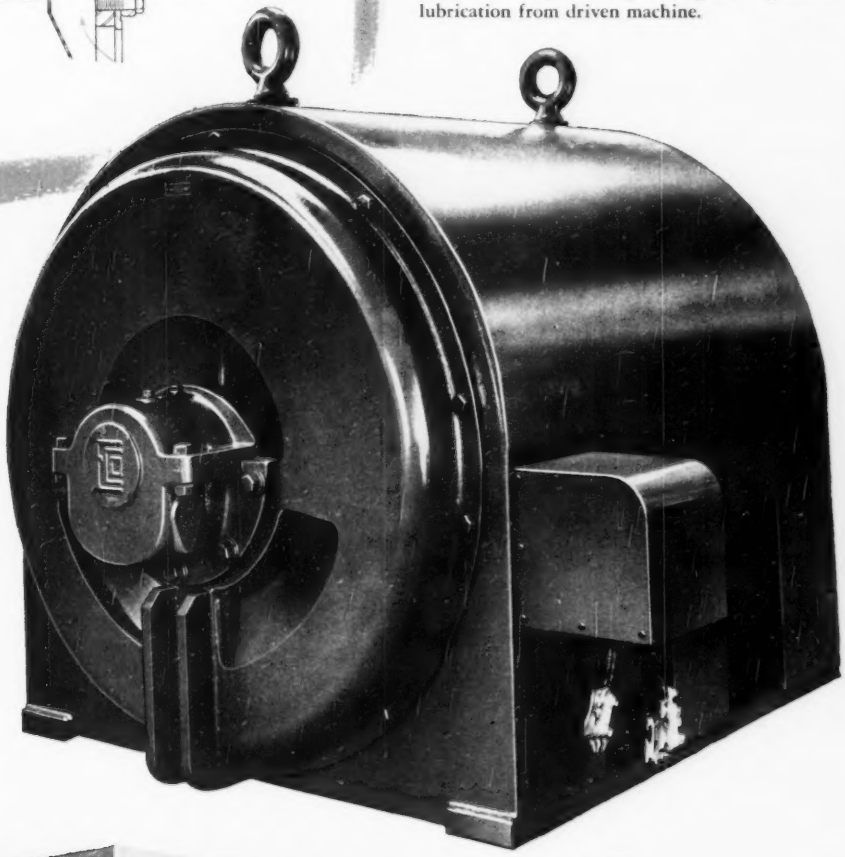
Elliott

ticket in this big motor



Air under pressure from the rotor fan, is forced down a tube to the inboard labyrinth shaft seal nearest the rotor fan. Then into the annular space between the two sets of inboard labyrinth seals and along cored passages in the flanges of the upper half of bearing housing, and is vented to atmosphere outside the motor through registering holes in lower flanges. In this one-way trip, all oil vapor is picked up and expelled.

Below: One of three 1250 hp 2 pole Elliott Fabri-Steel Motors for driving boiler feed pumps in a mid-west utility. Bearings arranged for pressure lubrication from driven machine.



FABRI-STEEL Motors

L-797

There's good reason for CREOSOTE OIL'S *popularity*

● Year after year, the wood preserving industry uses more creosote oil than all other preservatives combined for the treatment of poles and crossarms. In 1948, for example, creosote oil was used in the treatment of 93.8% of treated poles and 87.1% of treated crossarms.*

That's because creosote oil is recognized as a time-tested preservative; its reputation is based on years of satisfactory protective service.

For the best possible results from creosote oil, it will pay you to specify or use U·S·S Creosote Oil. Its unvarying uniformity, adequate penetration and high toxicity combine to add years of life to poles and crossarms . . . hold down future replacement costs.

The extensive facilities of United States Steel are your assurance of quality and service.

*Wood Preservation Statistics, Forest Service, U.S.D.A., in cooperation with American Wood Preservers' Association.

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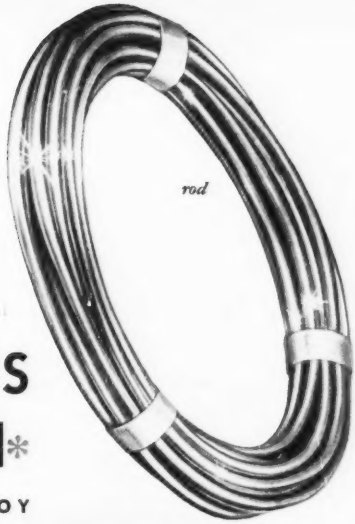
UNITED STATES STEEL



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Here's the stuff directly responsible for today's widespread use of electric heat. It's Hoskins CHROMEL . . . the *original* nickel-chromium resistance alloy that *first* made electrical heating practical way back in 1906. Ductile, durable, hard-to-burn out, it possesses close-to-constant "hot" resistance between 700° and 2000° F. . . . delivers full-rated power throughout its long and useful life. And it's produced to a uniform tolerance of resistance as wire, ribbon, or rod to meet the requirements of a wide range of domestic and industrial applications. So if you're concerned with electric heat . . . from a load-building point of view, as a manufacturer of heating devices, or as a user of electric heat in your manufacturing processes . . . you'll do well to get acquainted with Hoskins CHROMEL. Complete technical information is contained in our Catalog M-1 . . . want a copy?

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Heating Element Alloys ★ Heat Resistant Alloys ★ Thermocouple Alloys ★ Spark Plug Electrode Wire ★ Special Alloys of Nickel ★ Electric Heat Treating and Laboratory Furnaces

Chromel® nickel-chromium alloy

Cables run COOLER... in TRANSITE DUCTS

. . . reducing copper losses

. . . increasing current capacity

. . . prolonging insulation life

HERE'S HOW to reduce copper losses . . . increase current carrying capacity . . . and prolong insulation life—run your cables in Transite* Ducts.

Current carrying capacities can be increased in a typical duct bank as much as 5%, or I^2R losses can be reduced 11%, for cables located in Transite as compared with other ducts used for power circuits.

And, Transite Ducts assure permanent duct banks because Transite is incombustible; is immune to rust and rot; is unaffected by electrolysis; will not slag under action of an arc, and will retain its high original strength.

An unusually smooth bore assures no injury to cable sheath, either in natural movement under load, or when pulling-in cables. Long, lightweight lengths can be quickly and economically installed.

In addition, a full line of fittings simplifies even the most complicated of installations.

For full information on Transite Ducts, write for Data Book DS-410. Johns-Manville, Box 290, New York 16, N. Y.

*Reg. U. S. Pat. Off.

How Transite Ducts increase current carrying capacities

Type cable 3 cdr. 500 MCM Compack Sector, 15 KV (6th Edition AEIC Spec.)
No. of cables—3 (all loaded in one bank)
Daily Load Factor—75%
Earth Temp. ambient—20 C

	Transite	Other
Total Therm. Res. to Dielectric Loss (C watts/ft.)	5.66	6.17
Total Therm. Res. to Copper Loss (C watts/ft.)	4.44	4.95
Temp. Rise from Dielectric Loss (C)	1.9	2.1
Allowable Rise for Copper Loss (C)	59.1	58.9
Allowable Watts per ft. cable	4.44	3.96
Allowable Current—(Amps. per cdr.)	386.	365
Allowable Current—(Relative %)	105.6	100

Johns-Manville *Transite Ducts* **"KORDUCT"— for encasement in concrete**

"CONDUIT"— for use exposed and underground without encasement

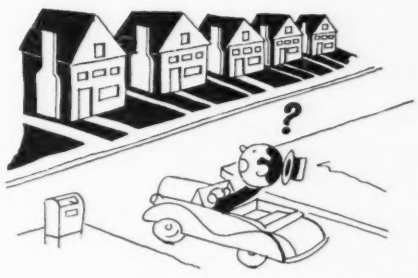
How to keep costs down with OZALID

Your Ozalid operation *should* be the simplest, most inexpensive business system in your organization.

If it isn't, check these two factors:

1. Always use Ozalid sensitized materials in your Ozalid machine. Month after month, package after package, Ozalid materials are *uniform*. Printing speed, fade-resistance, physical strength, density, and eleven other characteristics are kept in scrupulous balance so that one batch of paper gives you the same results as the last one . . . or the next one!

Thus your Ozalid operator's time is spent in printing —not in studying the characteristics of vastly differing diazo materials.



2. Ozalid's nationwide service organization is as near as your telephone book. Let these trained technicians and business wizards keep your Ozalid operation in tiptop form. They'll keep your Ozalid machine in super-efficient working condition, as well as help you set up new methods of getting more work done with less effort . . . through Ozalid!

If you have an Ozalid machine, are using Ozalid materials and taking advantage of the national Ozalid service organization . . . *you're saving time and money!*

If you do not have an Ozalid machine, it's time you found out how error-proof Ozalid duplicates anything typed, drawn, written, or printed (on translucent paper) in seconds! Write today. Or look up your Ozalid distributor in the classified book and call him!

Don't copy . . . use

OZALID!

Ozalid, Johnson City, N. Y., Dept. 128
A Division of General Aniline and Film Corporation
"From Research to Reality"

HERE'S WHY NEOPRENE PRODUCTS DO SO MANY JOBS SO WELL

They resist
OXIDATION by air, oxygen, ozone—have outstanding resistance to aging.

They resist
HEAT—are exceptionally stable at temperatures up to 250° F.

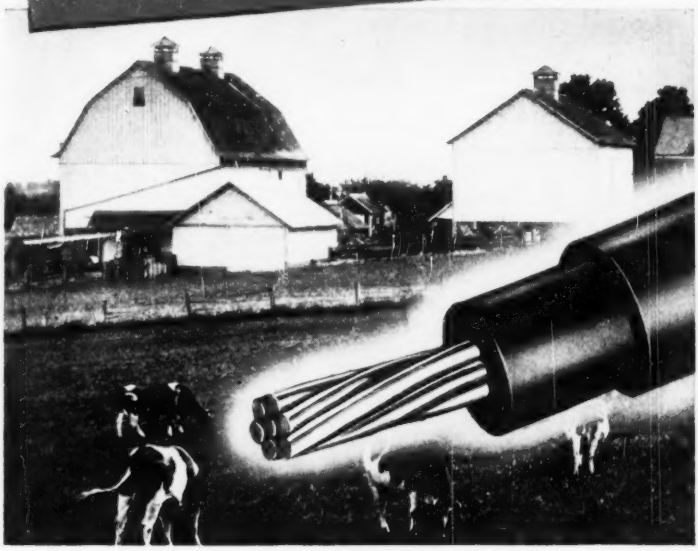
They resist
SUNLIGHT AND WEATHERING—in a class by themselves in resistance to rubber's worst enemies.

They resist
OILS, SOLVENTS, MOST CHEMICALS—set the standard for oil resistance throughout industry.

They resist
ABRASION, CUTTING, CHIPPING—are tough and durable under severe service conditions.

FREE! THE NEOPRENE NOTEBOOK—Interesting stories... new, unusual applications of neoprene. Write E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division G-12, Wilmington 98, Delaware.

Better wire and cable are made with Du Pont NEOPRENE



for example:

Neoprene-jacketed cable, laid underground, is practical and economical for farm wiring

Engineers designed this cable for direct burial in the soil. Safely underground, it withstands deterioration from soil acids, alkalies, organic decay and animal feces because it is jacketed with a tough, long-lasting armor of Du Pont neoprene. Pictured above is a farm wired with this cable. Note that there's not a pole or wire anywhere to get in the way of even the largest, most cumbersome farm machinery. And, costly wire damage from storms and falling trees is eliminated.

This same cable can also be installed overhead if necessary. For the neoprene jacket withstands broiling sun, weathering, heat and aging, too.

This is but one example of how neoprene contributes to cable efficiency, lower maintenance costs, better power service. There are other neoprene constructions to fit your specific power distribution needs. Although Du Pont does not make finished products of neoprene, your cable supplier will be glad to tell you about the many types of neoprene-jacketed wire and cable available. If you need a source of supply for wire and cable, or want additional information on neoprene, write:

E. I. du Pont de Nemours & Co. (Inc.)
Rubber Chemicals Division G-12
Wilmington 98, Delaware

NEOPRENE
the rubber made by Du Pont since 1932
DU PONT
REG. U.S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

Hughes DEPENDABLE X-BRACED TRANSMISSION STRUCTURES

Tangent structures as used on transmission lines of voltages of 110-115 KV and higher construction. Similar structures are also used for 69 KV to 220 KV operation.

Cross arms, bracing, and hardware are designed for the individual application.

Specifications for Structure shown:

Normal Span—700'
Conductor—4/0 ACSR

"HUGHES" Factory Assembled Double Arms. 3½" x 8¼" x 30'-0" with No. 2880 metal spacer fittings.

"X" Braces are "HUGHES" standard No. 1042.

"Knee" Braces are "HUGHES" standard No. 2935.

HUGHES BROTHERS developed and pioneered "X-Braced" construction, worked out the structural theory, and confirmed it by full-sized tests. The results: Thoroughly reliable transmission systems, and savings of millions of dollars for the electric utility industry.

Manufacturers of

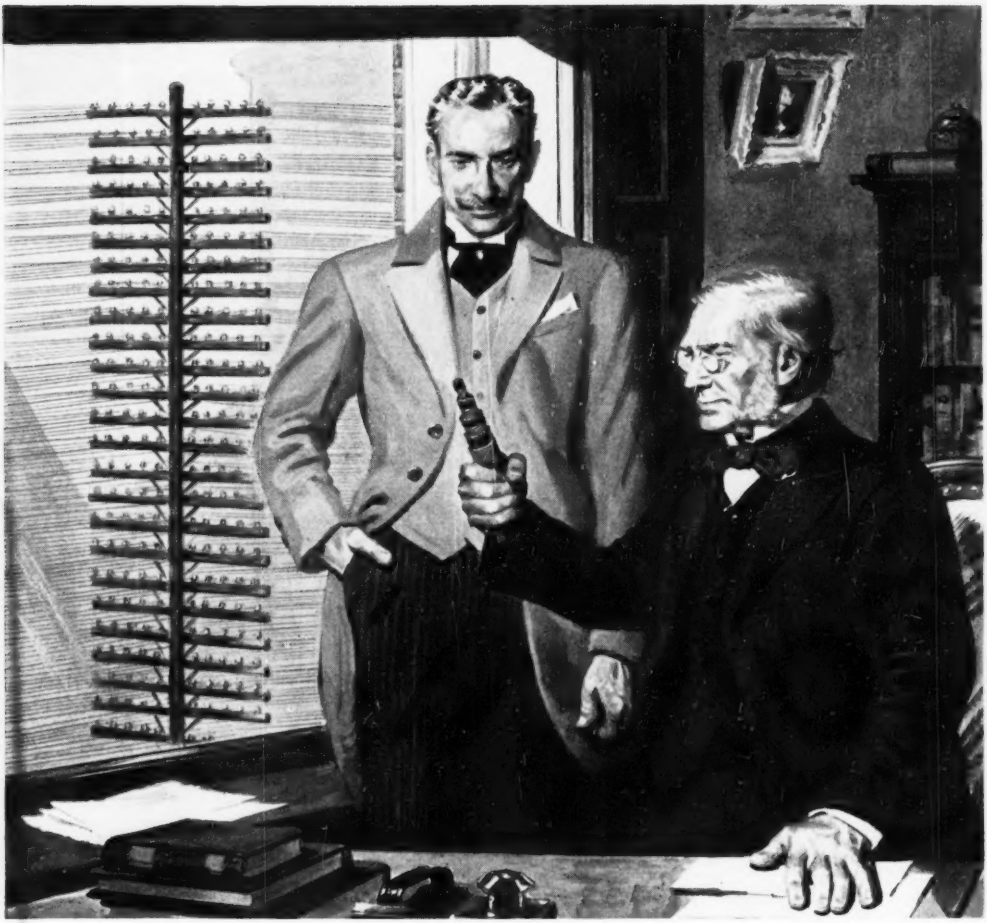
Transmission and Distribution Structures • Transmission Line Hardware • Prefabricated Wood Substations • Transformer Platforms • Wood Bayonets • Special Wood and Steel Items.

WHEN IT'S HUGHES . . . *It's Tailored* TO YOUR NEEDS

HUGHES SEWARD FOUNDED - 1921

"HUGHES" TRANSMISSION & DISTRIBUTION WOOD METAL MATERIAL MEN

BROTHERS NEBRASKA INCORPORATED



They Packed a Pole Line Into a Pipe

Back in the eighties, telephone executives faced a dilemma. The public demanded more telephone service. But too often, overloaded telephone poles just couldn't carry the extra wires needed, and in cities there was no room for extra poles. Could wires be packed away in cables underground?

Yes, but in those days wires in cables were only fair conductors of voice vibrations, good only for very short distances. Gradually cables were improved; soon every city call could travel underground; by the early 1900's even cities far apart could be linked by cable.

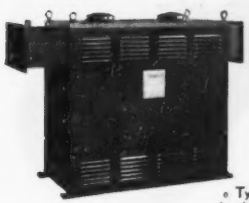
Then Bell scientists went on to devise ways to get more service out of the wires. They evolved carrier systems which transmit 3, 12, or even 15 voices over a pair of long distance wires. A coaxial cable can carry 1800 conversations or six television pictures. This is another product of the centralized research that means still better service for you in the future.

BELL TELEPHONE LABORATORIES *EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE*

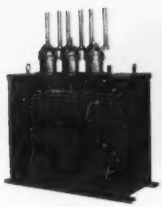
The ink is dry!

. . . ON A NEW DRY TYPE TRANSFORMER BULLETIN

• 200 KVA air cooled transformer with terminal chambers.



• Type MGT, 600 KVA load center transformer with high voltage terminal chamber and low voltage throat for connection to bus-duct.



• Load center transformer with high voltage gang operated oil fused cutouts.

• Type MC, compound filled transformer, sizes through .750 KVA arranged for pipe or wall mounting . . . (with terminal chamber).

• Your copy of the new Standard Dry Type Transformer Bulletin is waiting for you.

On its 16 colorful pages, you'll find a wealth of material on the design, construction, installation and operational advantages of Standard Dry Type Transformers.

Actual photographs of the units plus numerous dimensional drawings and tables make the story complete . . . a must for your files. Write for it today.

Standard

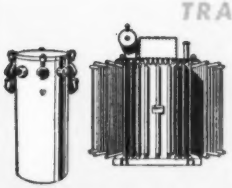
TRADE MARK ®

THE STANDARD TRANSFORMER COMPANY

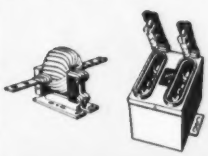
WARREN, OHIO

Representatives in Principal Cities

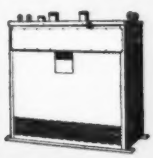
TRANSFORMERS FOR EVERY APPLICATION



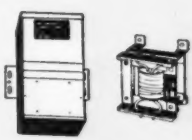
Liquid filled (sizes up to 10,000 KVA and 72 KV inc.)



Instrument transformers (for use on circuits up to 72,000 volts, inc.)



Dry type (up to 1000 KVA and max. voltage ratings of 4800)



Control transformers (compound filled or open type)

What makes a good tape GOOD?

To manufacture good serviceable tape certain standards must be met. A short cut on any one point would result in a sub-standard product. Accurate production strictly adheres to the 5 quality points below—at all times.

1 Fine strong straight woven cotton fabric base.

2 High quality, clean rubbers scientifically blended to form a stable, tacky, adhesive impregnating compound.

3 Impregnation of the sheeting with the compound by steel calendar rolls operating at different peripheral (friction) speeds. That's where friction tape gets its name. Tape made by less costly methods isn't genuine friction tape.

4 Slitting to desired width on specially designed machines to assure clean, non-raveling edges.

5 Proper packaging in handy protective cartons and tins to keep tape clean.

That's the way ACCURATE Friction Tape is made. It's the reason every foot is of consistently high quality. Friction or rubber, use ACCURATE Tapes for best results because all are made to highest standards for your protection. There is an ACCURATE distributor near you. Ask for his name today. Just write Accurate Mfg. Company, Garfield, New Jersey.

MEMO FOR CONTRACTORS!

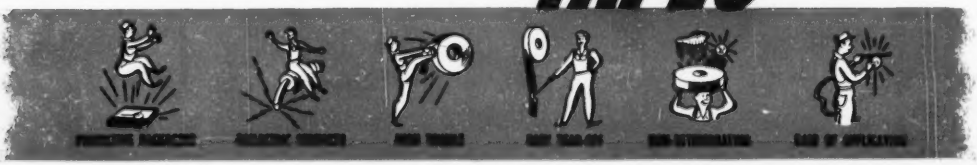
THE HANDY TO-ROLL PROTECTIVE CONTAINER

Keeps tape clean and fresh on the job. It's a good idea to have a few always on hand in your field stockroom, ready for use when you need it.

ACCURATE

25 YEARS MAKING TAPES EXCLUSIVELY

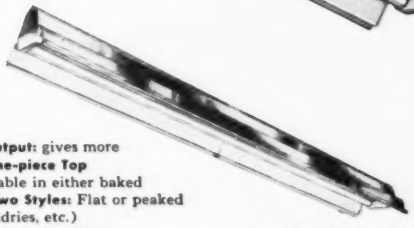
TAPES



modernize your plant lighting with the Wheeler T-12 slimline fixture

NEW

Here's the latest product of Wheeler "Skilled Lighting"! It reflects almost 70 years of design and engineering experience in the manufacture of top-value lighting equipment. This new addition to the Wheeler Line is offered in two styles . . . with flat top channel for ordinary plant locations; with peaked top for locations where excessive moisture and dust-laden air conditions exist.



PEAKED TOP MODEL

6 Better-Value Features **1. High Output:** gives more light per foot of lamp length. **2. One-piece Top Channels:** made of heavy gage steel. Available in either baked enamel or vitreous porcelain enamel finish. **3. Two Styles:** Flat or peaked top channels (the latter for textile mills, foundries, etc.) **4 Reflectors in Sections:** for greater ease in handling, each unit furnished with two open-end-type porcelain enamel reflectors. **5. Individual or Continuous Mounting. 6. Latest G.E. Twin-Turret Type Lampholders** (depressable): for single pin contact, making lamp insertion and removal simple.

The new T-12 Slimline Unit is designed for use with two 75 watt, 96" T-12 Slimline single pin lamps (instant starting) operating at 425 MA. Send for complete details of this new "Skilled Lighting" fixture built to stay new-looking for years. *Wheeler Reflector Company, 275 Congress St., Boston 10, Mass.* Also New York, N. Y. Representatives in principal cities.

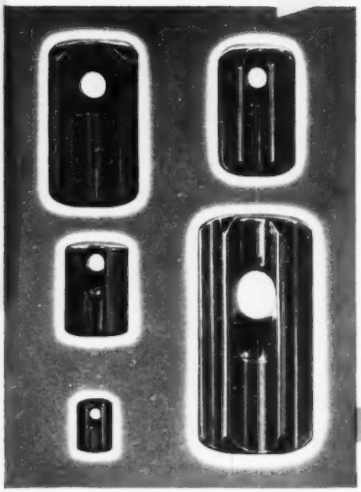
DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

Wheeler REFLECTORS SKILLED LIGHTING

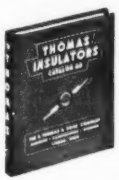
MADE BY SPECIALISTS IN LIGHTING EQUIPMENT SINCE 1881

STANDARDS of DISTRIBUTION QUALITY

Porcelain Pioneers For 76 Years



No matter what your porcelain insulator requirements, THOMAS can satisfy them . . . whether for high-voltage transmission or low-voltage distribution. Specifically, our distribution porcelain and hardware are backed by the same 76 years of ceramic experience and knowledge which distinguish THOMAS high-voltage suspension and pin-type designs. Consequently, THOMAS porcelain is the standard of comparison for discriminating engineers throughout the Electrical Industry. Make it *your* safeguard for reliable electrical distribution. *Always specify THOMAS—the best by line test.*



THIS FREE CATALOG

. . . illustrates and describes the complete THOMAS line. Enclosed in a loose-leaf binder, it provides a ready reference for all Transmission-Distribution Insulators and associated Line Hardware. New Insertions, as issued, are sent to all catalog holders.

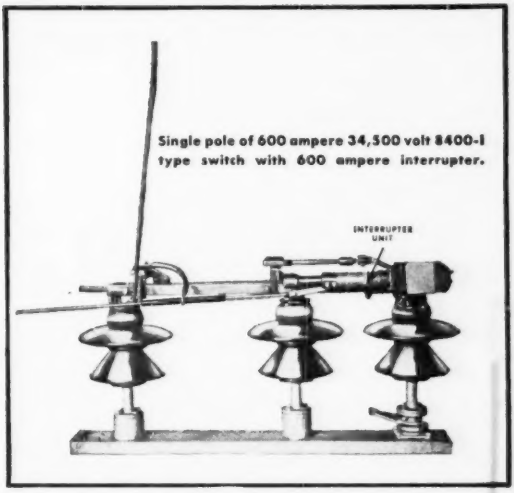
The R. Thomas and Sons Co.

LISBON, OHIO
NEW YORK CHICAGO
AGENTS IN PRINCIPAL CITIES

Are you getting a MODERN EFFICIENT SWITCH?

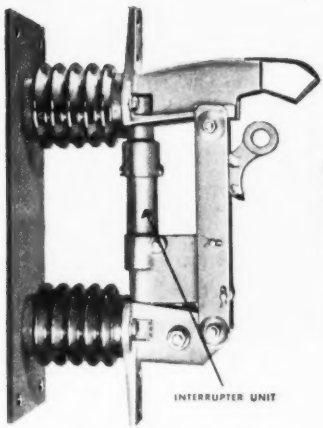
In selecting your power switching equipment, are you meeting today's fast developing new conditions, and also keeping an eye to the future? Constantly increasing loads demand more flexibility in operation. Greater efficiency in switching lines and feeders are a "must" for today and tomorrow. The best way to make sure you are keeping abreast with these conditions is to

SPECIFY THREE E AIR INTERRUPTER SWITCHES



Single pole of 600 ampere 34,500 volt 8400-I type switch with 600 ampere interrupter.

Outdoor switches are available up to 46,000 volts with 600 ampere interrupting capacity and up to 69,000 volts with 200 ampere interrupting capacity. Ask for Bulletin 331.



Single pole of 600 ampere 15,000 volt switch with 600 ampere interrupter.

Indoor switches are available up to 15,000 volts and to 600 ampere interrupting capacity. Ask for Bulletin 141.

Our patented interrupter unit enables these switching operations to be successfully performed.

1. Interrupt load current up to rated capacity.
2. Sectionalizing feeder and distribution circuits.
3. Interrupting magnetizing current of transformers.
4. Interrupting charging current of busses, lines and cables.
5. Interrupting exciting current of feeder regulators.
6. Switching charging current of capacitor banks.

- The arc created by circuit interruption is confined and extinguished inside the arcing chamber of the interrupter unit. There is no burning or pitting of contacts and no system disturbances.
- 115,000 volt switches are also available for special applications.

There are thirty-five Three E selling representatives located throughout the larger cities of the United States. Call the one nearest you.

IN CANADA

Northern Electric
COMPANY LIMITED
In all the Dominion's larger cities

IN MEXICO

Sociedad Electro-Mecanica
Serapio Rendon No. 84
Mexico, D. F.

THREE E — ELECTRICAL ENGINEERS EQUIPMENT CO. — MELROSE PARK, ILL. U.S.A. — THE MARK OF QUALITY

ELECTRICAL ENGINEERS EQUIPMENT CO.
MELROSE PARK, ILLINOIS

"We Reduced Costly and Troublesome Shutdowns Due To Needless Blows On A Circuit Serving 3 Arc Welders"

"In the Truck Service Garage in Casper, we have the job of servicing three 220 volt arc welders connected to a 60 ampere switch. Frequently all these welders are thrown on the line at the same time.

"This causes a heavy rush of current that generally blew the 60 ampere renewable fuses we formerly used to protect the circuit.

"The resulting shutdowns were very costly to our customer and troublesome to us.

"During 1947 we decided to see if Fusetron dual-element fuses would help cure the trouble and so installed three 60 ampere ones in the switch.

"That was many months ago but so far not one Fusetron fuse has blown on the starting current of the welders.

"You can take it from us Fusetron dual-element fuses really do eliminate needless shutdowns."

Geo. Forster, President
FORSTER ELECTRIC COMPANY,
Casper, Wyoming

When We Installed . . .

(FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

Facts About FUSETRON Dual-Element FUSES

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

Fusetron DUAL-ELEMENT Fuses

with their

10 Point Protection

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

STOP *Wasting Time and Money —*

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

FUSETRON Dual-Element Fuses Give ALL-PURPOSE PROTECTION

One needless shutdown — or one lost motor — or one destroyed switch or panel — may cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse.

Don't risk such losses — protect yourself by installing a FUSETRON dual-element fuse in every set of fuse clips throughout the entire electrical system.

(FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

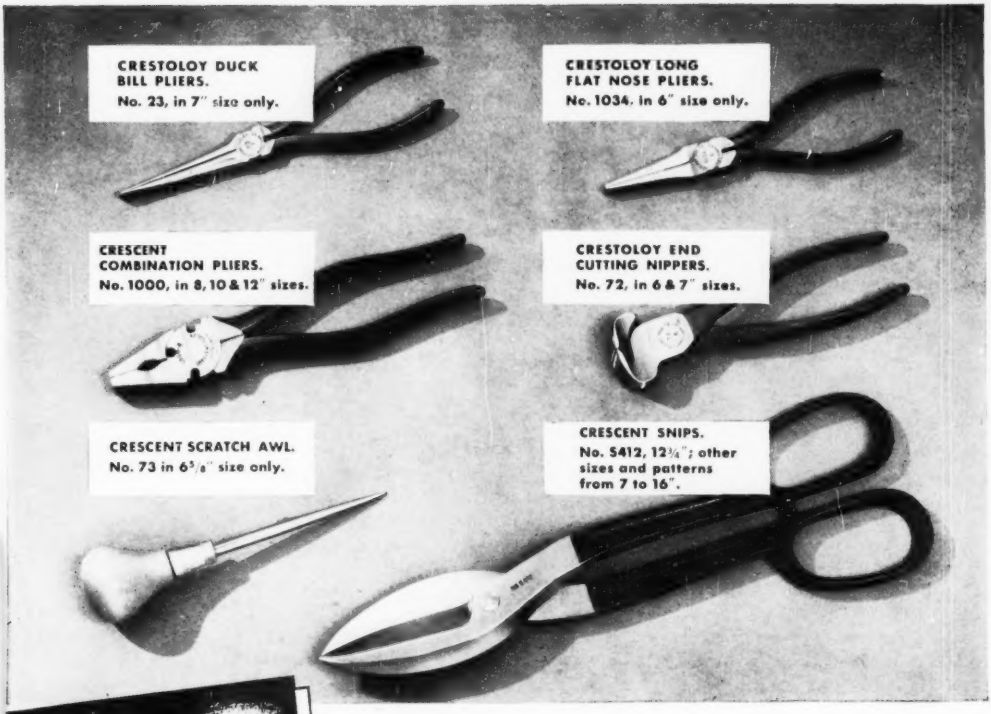
*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City & Zone*_____ *State*_____ 1249

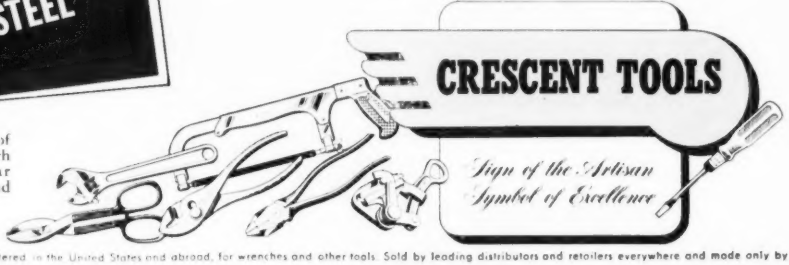

CRESTOLOY DUCK BILL PLIERS.
No. 23, in 7" size only.
CRESTOLOY LONG FLAT NOSE PLIERS.
No. 1034, in 6" size only.
CRESCENT COMBINATION PLIERS.
No. 1000, in 8, 10 & 12" sizes.
CRESTOLOY END CUTTING NIPPERS.
No. 72, in 6 & 7" sizes.
CRESCENT SCRATCH AWL.
No. 73 in 6 5/8" size only.
CRESCENT SNIPS.
No. S412, 12 3/4"; other sizes and patterns from 7 to 16".

GOOD TOOLS

. . . save time . . . reduce costs

Users of Crescent and Crestoloy Tools have long since learned the economy of paying just a little more (than "cheap" tools cost) to get a whole lot more in hand tool quality. Superior tool design not only reduces worker fatigue but produces more and better output. The longer life of Crescent and Crestoloy Tools definitely reduces maintenance and replacement costs.

Write for your copy of this little folder which illustrates 21 popular patterns of Crescent and Crestoloy Pliers.



"Crescent" is our trade mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

Announcing!

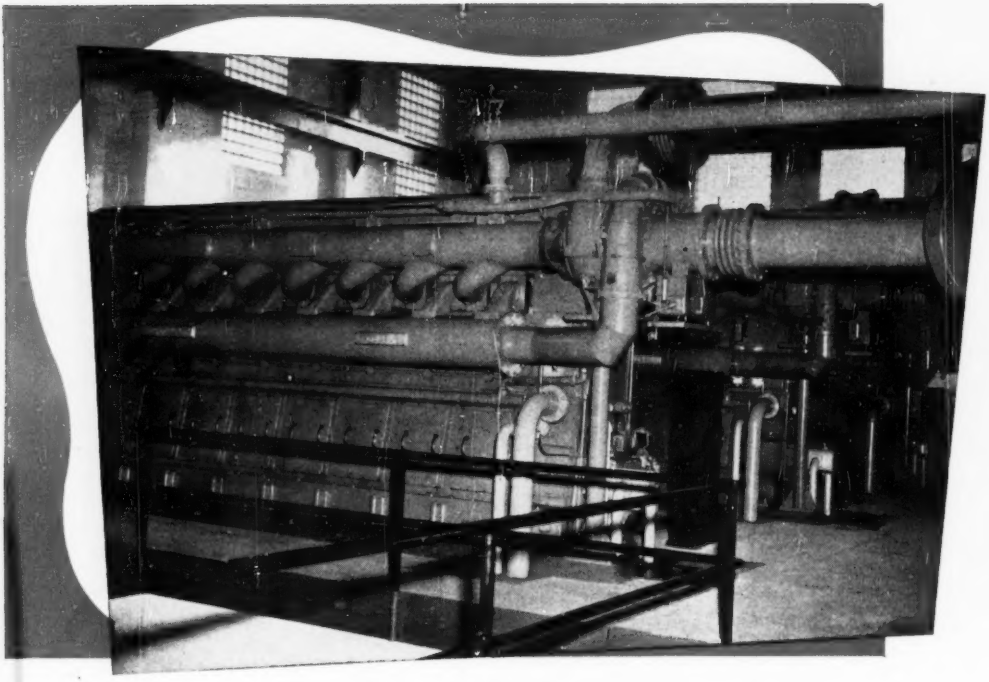
The WATTHOUR METER "that keeps in step with load growth"

ROLLER-SMITH TYPE S-3

Catalog 4425
Contains
Complete Information

ROLLER-SMITH BETHLEHEM PENNA.

INSTRUMENTS • RELAYS • SWITCHES • CIRCUIT BREAKERS • POWER SWITCHING EQUIPMENT • SWITCHGEAR



This is the way a dream came true

For 50 years officials of a Michigan town planned and worked to secure an adequate source of electrical power.

Over the years they gradually acquired property and rights for extracting power from the river that ran through the town. Finally it became apparent that there wasn't enough water to produce all the electrical power needed by a fast-growing community.

But they made their dream come true by building a generating plant powered by three 1440 hp, supercharged Superior Diesels, driving generators capable of delivering a total of 3000 kw. Now they have a source of power that will serve them today and for many, many years in the future as well.

If you are interested in securing an adequate and dependable source of power, investigate the advantages Superior Diesels have to offer. They have proved their value over and over again when used for water supply systems, sewage disposal plants, airport lighting and many other vital services.

Superior Diesels are made in supercharged and non-supercharged models that range from 170 to 1500 horsepower. One of our field engineers will be glad to discuss the advantages of these engines with you.

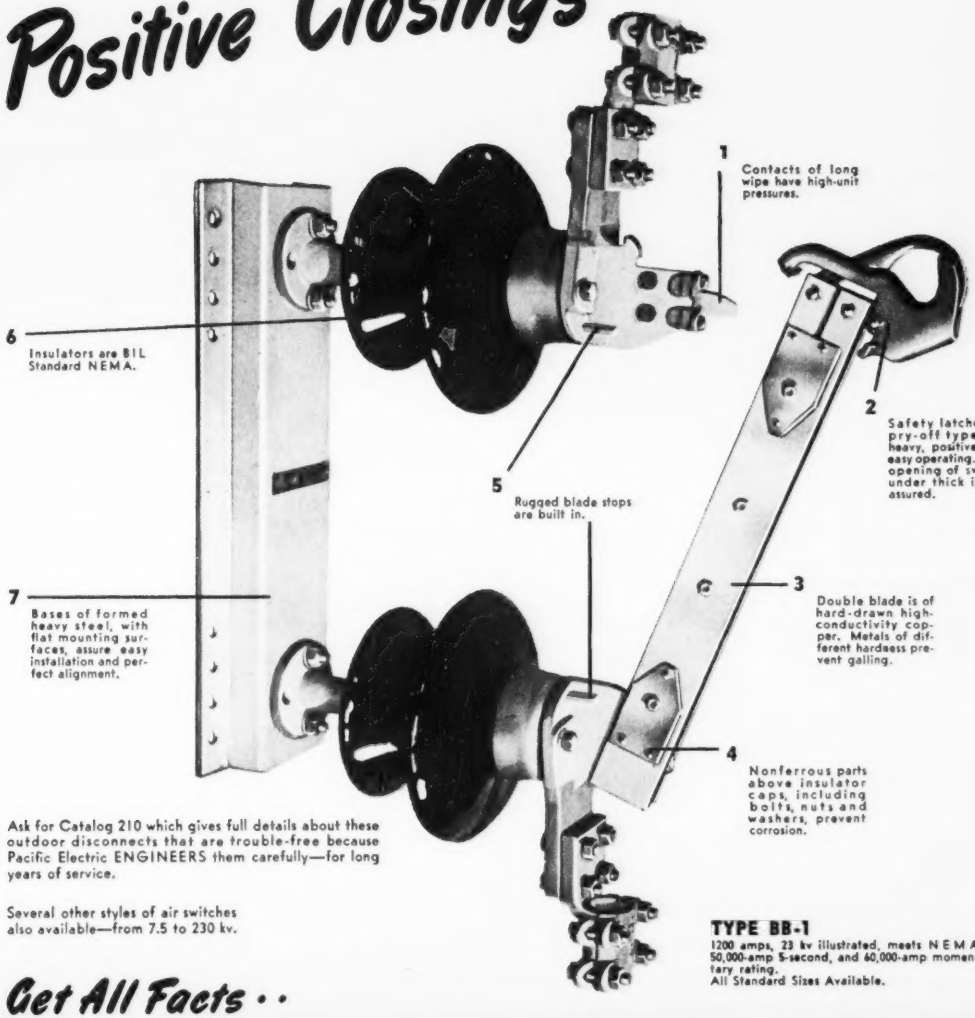
THE NATIONAL SUPPLY COMPANY
SUPERIOR ENGINE DIVISION
Plant and General Sales Office: Springfield, Ohio

THE NATIONAL SUPPLY COMPANY NSCO

Superior DIESEL

OUTDOOR DISCONNECTS

Easy, Pry-Off Openings— Positive Closings


1
Contacts of long wipe have high-unit pressures.
2
Safety latches of pry-off type are heavy, positive and easy operating. Easy opening of switch under thick ice is assured.
3
Double blade is of hard-drawn high-conductivity copper. Metals of different hardness prevent galling.
4
Nonferrous parts above insulator caps, including bolts, nuts and washers, prevent corrosion.
5
Rugged blade stops are built in.
6
Insulators are BIL Standard NEMA.
7
Bases of formed heavy steel, with flat mounting surfaces, assure easy installation and perfect alignment.

Ask for Catalog 210 which gives full details about these outdoor disconnects that are trouble-free because Pacific Electric ENGINEERS them carefully—for long years of service.

Several other styles of air switches also available—from 7.5 to 230 kv.

TYPE BB-1
1200 amps, 23 kv illustrated, meets N E M A 50,000-amp 5-second, and 60,000-amp momentary rating.
All Standard Sizes Available.

Get All Facts . .

Call

PACIFIC ELECTRIC MFG. CORPORATION

5815 THIRD STREET, SAN FRANCISCO 24, CALIFORNIA • P. O. BOX 419, GARY, INDIANA

C. H. CUTTER, 912 Securities Bldg., Seattle 1, Wash. · PIERCE G. FREDERICKS, 90 West St., New York 6, N. Y. · J. E. REDMOND SUPPLY CO., 625 W. Madison St., Phoenix, Ariz. · G. B. KIRKWOOD, 437 S. Hill St., Los Angeles 13, Calif. · MARRS & WENDEGATZ, 526 Dwight Bldg., Kansas City 6, Mo. · KRIPPNER and POLLEY, 1 Downing St., Denver 9, Colo.

F. W. GORMAN, P. O. Box 223, El Paso, Texas · L. C. HARDIE, P. O. Box 1491, Des Moines 6, Iowa · BRUECK ENGINEERING CO., 53 W. Jackson Blvd., Chicago 4, Ill. · C. C. MUSGROVE, 506 Southland Bldg. Annex, Dallas 1, Texas · WILLIAMSON & WILMER INC., 617 Mutual Bldg., Richmond 19, Va. · EDGAR F. HUBERT CO., 510 Statler Bldg., Boston 16, Mass.

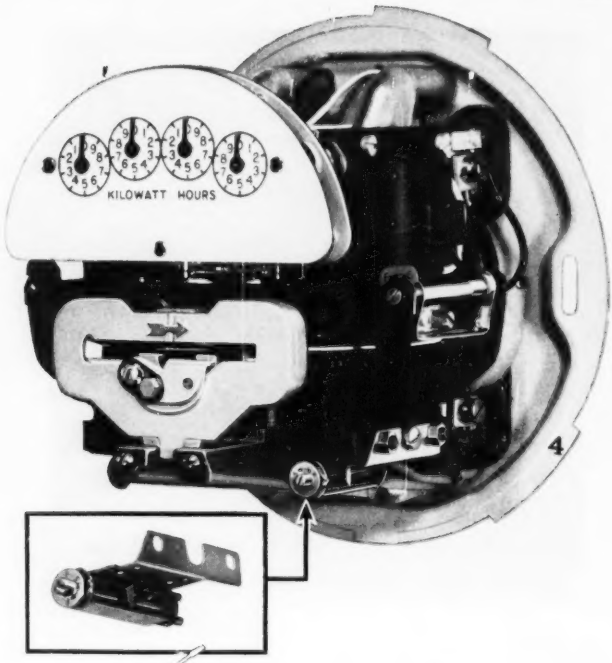
Other Representatives in Principal Cities

Power Factor Compensation is easy

with the new

SANGAMO

Polyphase
Watthour
Meter



a screwdriver is the only tool needed

Sangamo Type LC Polyphase Watthour Meters now feature a simple, extremely accurate micrometer adjustment for power factor compensation. This device consists of a slide wire held in compressive contact with a slider mounted on a threaded shaft. The slider moves when the slotted end of the shaft is turned with a screwdriver. The slotted adjustment shaft is readily accessible from the front in both two and three-element Type LC meters. Compensation is fixed within close limits by the position of the slider on the shaft. Both slider and slide wire are gold-plated to insure positive contact.

Provision for photo-electric testing has also been incorporated in these meters. This includes the addition of a circular hole 0.07 inches in diameter, near the edge of the disk, to provide a clear, vertical path for the light beam.

50TH ANNIVERSARY
SANGAMO
1899 - 1949

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

the greatest *Lighting Development* since the fluorescent lamp

custom-fits any commercial interior — at no more than the cost of ordinary fixtures!

exclusive MODULE plastic louver provides 40° transverse and longitudinal cutoff. Lamps are shielded at all normal viewing angles, yet light transmission is maximum.

A 4-14 Watt T-12 15" Type F Lamps

B 32-Watt 12" Cushine Lamp, and 1 PAR 20-or Flood Lamp

C 4-40 Watt T-12 48" Type F Lamps

D 4-75 Watt T-12 425 Ma. Lamp Slimline Lamps

these 4 low-cost modules are the "building blocks" of a perfect custom-fitting lighting installation . . .

they fit together perfectly end to side **end to end**

side to side **. . . to form more than 50,000 different lighting patterns**

. . . to fit any ceiling shape or size **. . . mixing all**

light sources **in one harmonious system . . . with**

equal brightness throughout **(no dark sides or ends) . . . so you**

can put the light where it is needed!

Only MITCHELL makes MODULE

MITCHELL MANUFACTURING COMPANY
2525 N. Clybourn Ave., Chicago 14, Illinois

Send free 20-page brochure describing MITCHELL MODULE.

*Firm Name*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

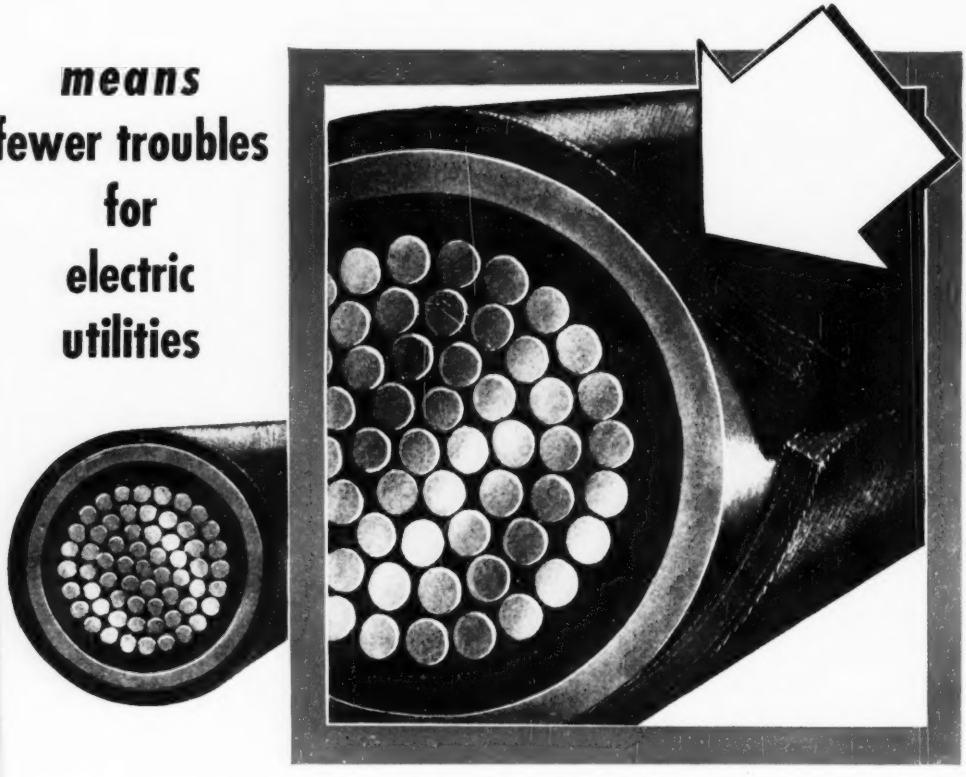
*Attention:*_____

MITCHELL **module**

REG U S PAT OFFICE

This glass-reinforced neoprene jacket

means fewer troubles for electric utilities



To prevent corrosion and to reduce the possibility of mechanical damage to underground power cables, both during and after installation, General Electric now offers a new, improved type of jacket, available on leaded cables installed in ducts, directly buried, or for aerial service.

Corrosion-proof glass tape and tough, age-defying neoprene are combined in this new jacket to provide an effective defense against moisture, soil acids and alkalies, and electrolytic corrosion—to take the hard knocks and mechanical abuses that occur during installation. Composed of spiral-wrapped, permanently strong glass tapes, coated and impregnated with a neoprene compound, thoroughly bonded and vulcanized together to form a tough, homogeneous mass—this newly-designed jacket gives the protection under rugged service conditions that utilities have been seeking for years. At the same time, the use of glass tapes permits a substantial reduction in the thickness of the jacket and of the lead sheath, resulting in a reduction in weight and diameter, and easier pulling during installation.

You can have all the advantages of this new jacket on your next job. It can be furnished, at your request, on all General Electric lead-covered cables, including gas- or oil-filled cables, used by utilities. For further information, call your General Electric Construction Materials district office, or write to Section W48-1227, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

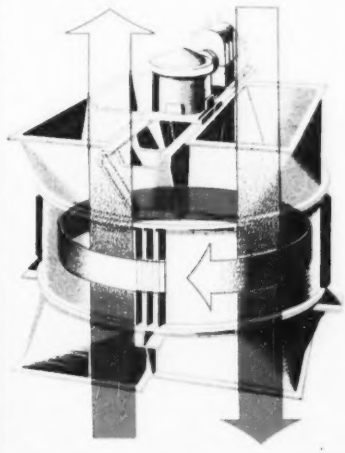
GENERAL ELECTRIC

Fact File on Preheat

No. 6

Cheaper grades of fuel can be used with the Ljungstrom air preheater. For in the Ljungstrom regenerative design heat does not pass through the metal. The elements therefore operate at a higher temperature . . . approximately a mean between the air and gas temperature. This permits safe operation at high recovery rates even with low grade or definitely corrosive fuels.

LJUNGSTROM



The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of leading power plants and other special applications confirm its high level of heat recovery and long-term low maintenance service.

THE

AIR PREHEATER CORPORATION

60 EAST 42ND STREET • NEW YORK 17, N. Y.

Plant: Wellsville, N. Y. 2879

In the home, too . . .

MALLORY ELKONITE* CONTACTS

Mean a Flip of a Switch Instead of a Hunt for a Fuse

Out go the lights! A "short"! Once it meant a mean trip to the cellar fuse box—often to find that the right fuse was missing. Now, in more and more homes, it simply means a flick of a nearby switch.

Equipped with Mallory-developed Elkonite Contacts, circuit interrupters have brought this new convenience. This same Elkonite is the contact material used in circuit breakers of giant power plants. Elkonite that served one of the world's largest test circuit breakers—at Grand Coulee—which interrupted 7½ *million kva*, more than twice the kva load of any breaker now in service.

With the protection of thousands of homes—and giant power stations—at stake, the circuit breaker contact has a huge responsibility. And Mallory Elkonite is equal to it. Made by a special process, Elkonite features hardness, conductivity, resistance to wear and impact, erosion by arcing, and sticking. It is one of many types of Mallory contact materials that meet wide applications.

What's Your Problem?

In fact Mallory has designed so many types that even if your problem is unusual, chances are that Mallory has a standard contact to meet it. If not, Mallory engineers are equipped to develop the precise one for you. Consult them now!

For all kinds of contact materials and service, you can't beat Mallory as a dependable, experienced source.

In Canada, made and sold by Johnson, Matthey & Mallory, Ltd., 110 Industry St., Toronto 15, Ontario.

Electrical Contacts and Contact Assemblies

P. R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

SERVING INDUSTRY WITH

Capacitors	Rectifiers
Contacts	Switches
Controls	Vibrators

Power Supplies

Resistance Welding Materials

*Reg. U. S. Pat. Off.

McCABE-POWERS AUTO BODY CO., 5900 N. Broadway, St. Louis 15, Mo.

Please furnish us literature on the following Powers Bodies:

☐ Service Bodies ☐ Meter Installation
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before you buy any utility bodies for 1950

Look—

AT THE FEATURES YOU GET IN

POWERS

PUBIC UTILITY BODIES

- Electrically welded all steel construction.
- Recessed slam action handles with cylinder locks.
- Extra large compartments with shelving and partitions for materials, tools and supplies.
- Triple-seal weathertight compartment doors.
- Saf-T Rolled Edges on all shelves and partitions.
- Remountable on new chassis.
- Clean Functional Design.

MAIL US the coupon above now for complete literature on POWERS' Public Utility Bodies for 1950! We'll send you informative material which thousands of utility men are finding very helpful in deciding on new equipment for next year's operation. Thus you can enter your 1950 budget conferences with the kind of data your management finds most useful in making equipment decisions! Thousands of POWERS' Public Utility Bodies are in use on large and small construction, maintenance and service operations. That's why POWERS is a favorite "buy-word" in the field today. You'll find them highly popular with line crews, who are enthusiastic about their efficient design, special features, ease of handling and many work-saving conveniences. Vitally important, your management will be impressed with POWERS' competitive pricing, as well as the economy of operating and maintaining these "work horses" of the public utility field. Contact us for full information—*mail the coupon above now!*

Delivery when you want it!

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"Bodies for '50!"

McCABE-POWERS AUTO BODY CO. • 5900 NORTH BROADWAY • ST. LOUIS 15, MISSOURI

Again Irvington leads the way . . . with the most complete line of Class "H" insulations obtainable. Now, manufacturers faced with high temperature problems can successfully meet each specific requirement from this broad line. Designers, too, faced with the need to design more compactly, or reduce weights, can select insulations exactly suited to their needs. These Irvington Class "H" insulations are furnished in many thicknesses, and widths up to 36". Complete information, and generous samples, gladly furnished on request.

"Look to Irvington
for continued leadership in insulation"

IRVINGTON
VARNISH & INSULATOR CO.
Irvington 11, New Jersey

*T. M. Reg. U. S. Pat. Off. by Owens Corning Fiberglas Corp.
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JUST OFF PRESS!

LOCKE'S ENLARGED

RM* HANDYLOG

...complete with

POLE LINE HARDWARE

Just 8 months ago Locke issued its first RM* Handylog. This edition listed . . . in 32 pages . . . all the power insulators and suspension hardware items needed for handling over 95% of your jobs. It was so well received by the industry that now Locke has expanded the original RM* Handylog to include Pole Line Hardware. The new edition lists . . . in 99 pages . . . *ALL* the Pole Line Hardware, as well as all the Power Insulators and Suspension Hardware, you need for handling over 95% of your jobs. Mail coupon today for your free copy. Place the RM items on your standards list . . . and benefit five ways:

1. **YOU SIMPLIFY** stocks and stocking operations.

2. **YOU PAY LOWEST PRICES** because RM items are standard items . . . produced in large quantities.

3. **YOU GET PROMPT SERVICE** because RM items are carried in stock by Locke Regional and Distributors' warehouses.

4. **YOU GET FAST DELIVERY** because RM items are always in production . . . on hand for immediate shipment from factory.

5. **YOU REDUCE CHANCES OF OBSOLESCENCE** because assured availability of RM items allows you to match future extensions to present construction.

*RM (Repetitive Manufacture)
A program designed to help reduce the installed cost per kilowatt on line and station equipment.

LOCKE
INCORPORATED
BALTIMORE, MARYLAND

MAIL THIS COUPON TODAY

LOCKE INCORPORATED
BALTIMORE, MARYLAND

Please send me my copy of Locke's new RM* Handylog.

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

Before you buy (stop!) **See what Locke's Got!**

Why Westinghouse Repair Service means *lower costs for you*

The cost of maintaining your electrical equipment is more than just the first cost of the repair job and the parts. It includes all your expenses of maintaining continuous production.

When you figure these expenses, Westinghouse Repair and Maintenance Service saves you important money:

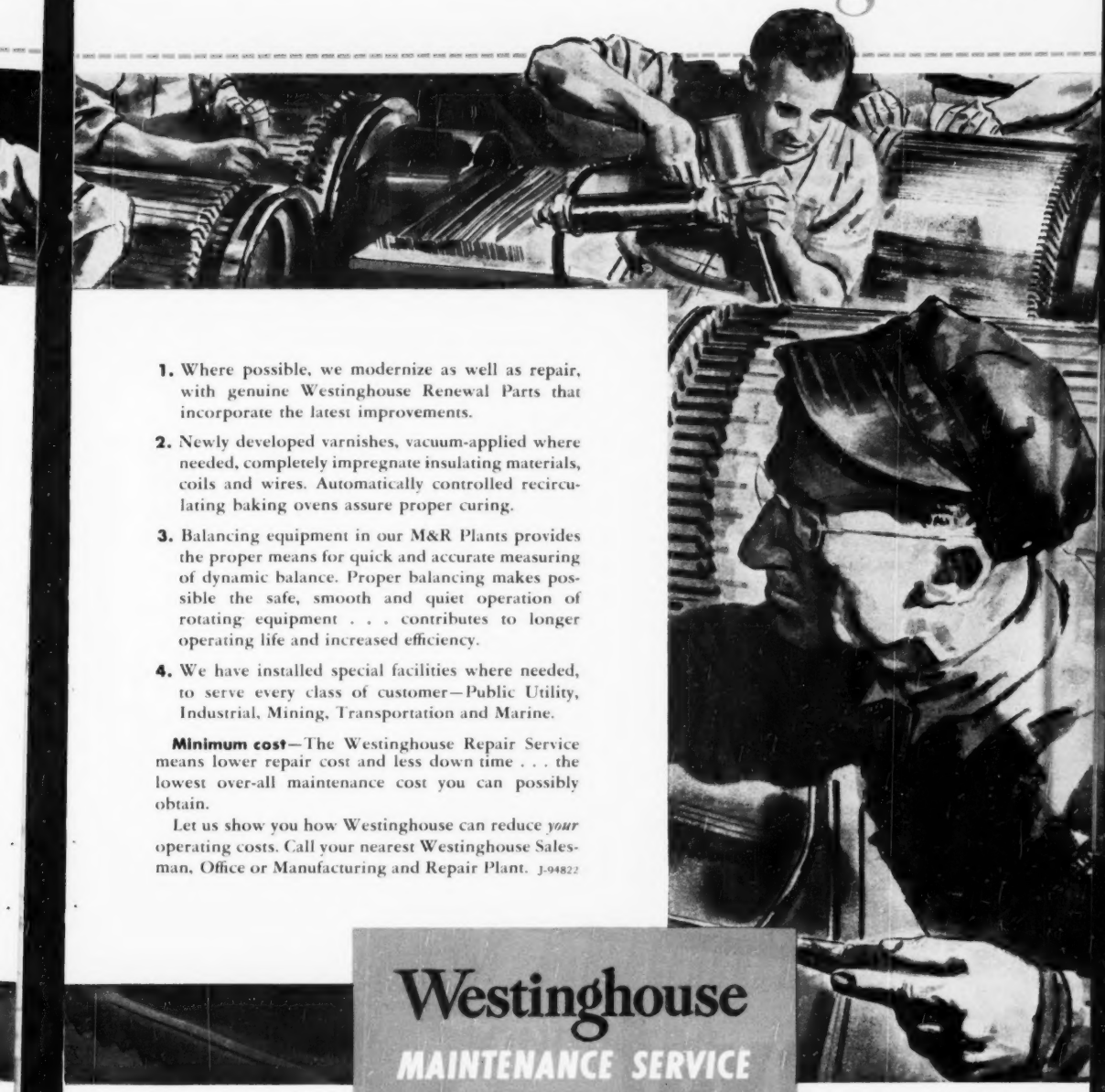
Fair prices—Our price schedules are set at a reasonable rate, made possible by our large volume of repair work. These prices are standardized throughout the country in our 36 Manufacturing and Repair Plants. Where needed, our Field Engineers make economical repairs in your own plant.

Guaranteed repairs—We guard against imperfections with rigid inspection standards, implemented with high-voltage, high-frequency surge comparative test equipment. With every rebuilding job goes the same one-year guarantee carried by new equipment.

Top performance—In repairing your equipment for top performance, we apply all new materials, tools and techniques developed throughout the Company. For example:

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



1. Where possible, we modernize as well as repair, with genuine Westinghouse Renewal Parts that incorporate the latest improvements.
2. Newly developed varnishes, vacuum-applied where needed, completely impregnate insulating materials, coils and wires. Automatically controlled recirculating baking ovens assure proper curing.
3. Balancing equipment in our M&R Plants provides the proper means for quick and accurate measuring of dynamic balance. Proper balancing makes possible the safe, smooth and quiet operation of rotating equipment . . . contributes to longer operating life and increased efficiency.
4. We have installed special facilities where needed, to serve every class of customer—Public Utility, Industrial, Mining, Transportation and Marine.

Minimum cost—The Westinghouse Repair Service means lower repair cost and less down time . . . the lowest over-all maintenance cost you can possibly obtain.

Let us show you how Westinghouse can reduce *your* operating costs. Call your nearest Westinghouse Salesman, Office or Manufacturing and Repair Plant. J-94822

Westinghouse

MAINTENANCE SERVICE

SHOP REPAIRS • FIELD REPAIRS

RENEWAL PARTS

NO HALFWAY MEASURES

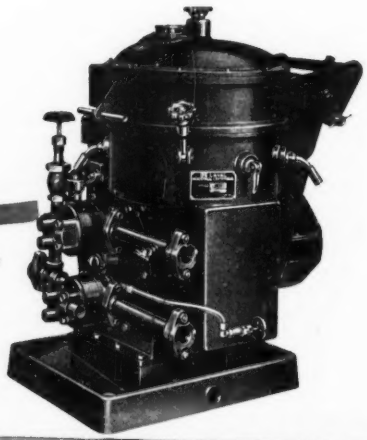
IN *my* TURBINE PROTECTION

"I am De Laval Centrifugal Force. When I protect a turbine my protection goes the whole distance. I remove **both** contaminants—***dirt*** and ***water***—and keep the lubricating oil at its best at all times."

It is never sufficient to remove just dirt from turbine oil. While dirt obviously soon ruins oil as a lubricant, as often as not the chief offender in that respect is ***water***. For water, either as condensate or in the form of a sudden leak, leads directly to the formation of sludge. It is also apt to emulsify the oil and cause serious difficulty in that way.

De Laval Oil Purifiers, wholly mechanical in action, remove dirt and continuously discharge the water, effecting separation by centrifugal force. The machines maintain full efficiency of purification right to the moment when the bowl is full of dirt and must be cleaned.

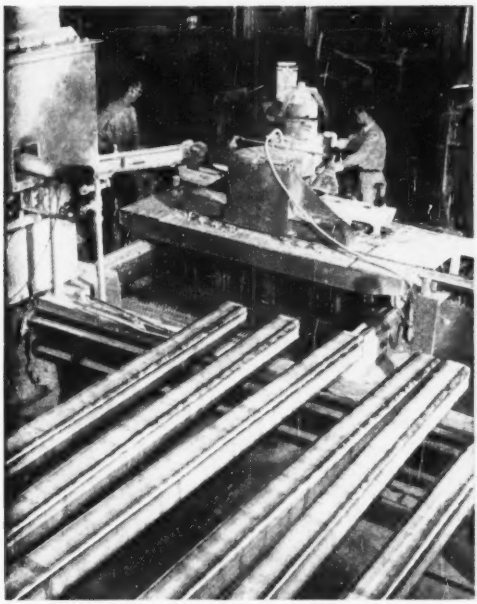
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.



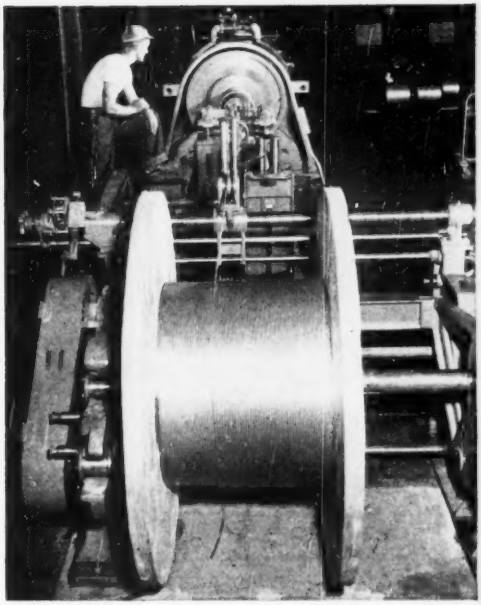
De Laval

OIL PURIFIERS *for more dependable power production*

From start . . . to finish . . .



AT KAISER ALUMINUM'S Newark, Ohio plant, the production of high quality Kaiser Aluminum conductor starts in the remelt department. Here high purity pig from its own reduction plants is remelted and cast into 99.5% purity ingots 6" square and 12' long. These pass through a series of automatic break-down and finishing mills to become rod ready for wire drawing.



ROD IS DRAWN into wire on the most modern equipment in the electrical conductor industry. High speed cable stranders, manned by skilled personnel, produce the finished conductor, which has been tested at every step by modern methods and equipment. Result of this completely integrated production control is pictured above—aluminum conductor of unsurpassed quality!

Controlled for quality!

As important as the high quality of Kaiser Aluminum Conductor is the consistently dependable deliveries assured by Kaiser Aluminum's centrally located Newark, Ohio plant.

Early delivery schedules of all sizes of ACSR and all-aluminum conductor are now open. For immediate information, contact any sales office listed below.

Produced by Kaiser Aluminum & Chemical Corporation.

Kaiser Aluminum

CONDUCTOR

SOLD BY KAISER ALUMINUM & CHEMICAL SALES, INC., KAISER BUILDING, OAKLAND 12, CALIF. . . . OFFICES IN: Atlanta • Boston • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Houston • Indianapolis • Kansas City • Los Angeles Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Portland, Ore. • Rochester, N. Y. • Seattle • Spokane • St. Louis Wichita • *Also available through General Electric Supply Corporation, Westinghouse Electric Supply Co., and Line Material Co.*

ORANGEBURG FIBRE CONDUIT

STANDARD
Installed with Concrete

NOCRETE
Installed without Concrete

Cables "Walled In" For Lifetime Service

UNDERGROUND

The ELECTRICAL ENGINEER realizes that the push of a button floods the home with light or sends power pulsing into the industrial machine *only when all's well with the underground cables.* ORANGEBURG CONDUIT helps keep these *life-lines long-lived.*

The *impermeable* walls and tight taper sleeve joints of ORANGEBURG CONDUIT protect cables *permanently* from corrosion . . . just as its smoother bore and low coefficient friction safeguard it *from* Cable Sheath Abrasion, *from* Pulling Tensions, *with* Cable Movement . . . facts proved by ORANGEBURG'S 50-year record underground.

Above ground, the news is also good . . . because ORANGEBURG CONDUIT combines unique strength and toughness with light weight, ease of handling, transportation and installation. These features together with its permanent resistance to corrosive ground waters and chemical wastes, provide a product that is low in *initial* and *maintenance* cost.

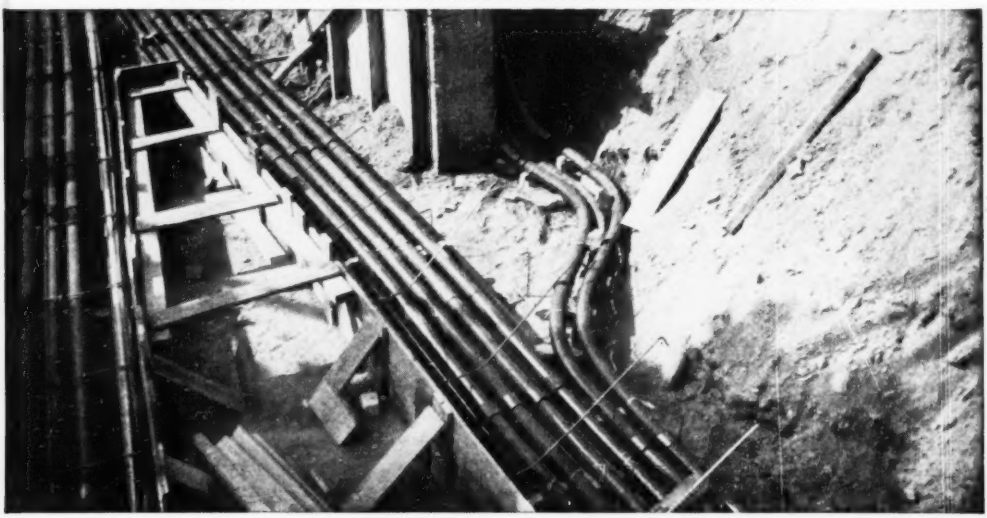
For more complete information write today for ORANGEBURG Catalog No. 50. Keep it for ready reference in your files.

ORANGEBURG STANDARD – For installation with concrete encasement. ORANGEBURG NOCRETE – For installation without concrete encasement.

Distributors · Graybar Electric Co., Inc.
General Electric Supply Corp.

Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y.

Illustration below is ORANGEBURG STANDARD *for installation with concrete encasement.*



users say

G. E.'S NEW ALL-PURPOSE* INSULATING VARNISH G-E 9574

Mr. J. Lindborg

From all parts of the country, enthusiastic reports are pouring in from users of G. E's new general-purpose varnish G-E 9574.

Here's a typical statement from J. Lindborg, owner and operator of AAA Electric Motor Service, Atlanta, Ga.

"Our experience has been that this varnish is as good as G. E. claims. It gives a good coat on every type of wire, bakes easily and dries to a tough coating that stands up perfectly in service. Also, this varnish works excellently with all types of coated wire and does not damage the insulation. We like the thinner, petroleum spirits, since it is cheap and can be purchased locally.

"During the two years we have been using this varnish we have had no complaints from any of our customers concerning our work."

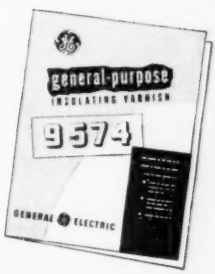
IF YOU HAVEN'T YET TRIED G-E 9574, get in touch with your local G-E Distributor, or write for our new bulletin to Section 25-12, Chemical Department, General Electric Company, Pittsfield, Massachusetts.

...bakes easily"

..."on every type of wire"

..."stands up perfectly in service"

*G-E 9574 gives excellent results on all types of coils except extra-high-speed armatures. It is one of G. E.'s complete line of electrical insulating materials.

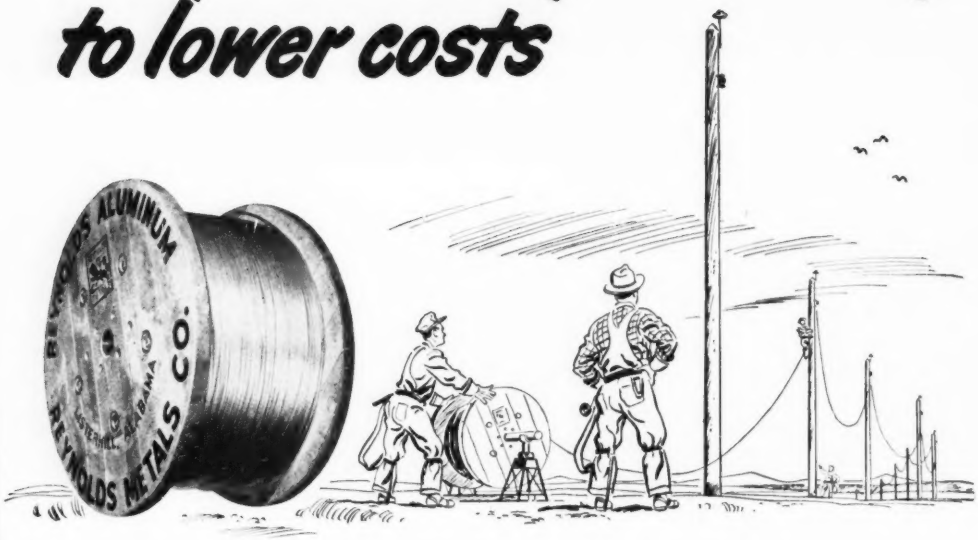


You can put your confidence in

GENERAL ELECTRIC

CD49-M6

Its lighter weight adds up to lower costs



START SAVING WITH REYNOLDS ACSR NOW!

IF you like savings in big chunks, you're certain to include Reynolds ACSR in your plans. This high strength yet lightweight conductor saves you money two ways in the field through (1) easier, faster stringing and (2) use of greater spans without increase in sag.

Remember, too, your first and major saving is made the moment you specify aluminum. Compared with copper, the initial cost of Reynolds ACSR is considerably lower. That's why more and more utilities are daily proving the fact that "when aluminum goes up costs come down."

Reynolds modern and expanded cable facilities assure you continued supply of this time and money saving conductor. For prices and complete product data, call the Reynolds field office listed under "Aluminum" in your classified telephone directory.

ACSR Manual for Engineers

Sag-tension charts, staking tables, stringing-sag tables, data on line design and erection—this and other helpful information are contained in this complete manual. Free when requested by letter. . . . Write to Reynolds Metals Company, Louisville 1, Kentucky.

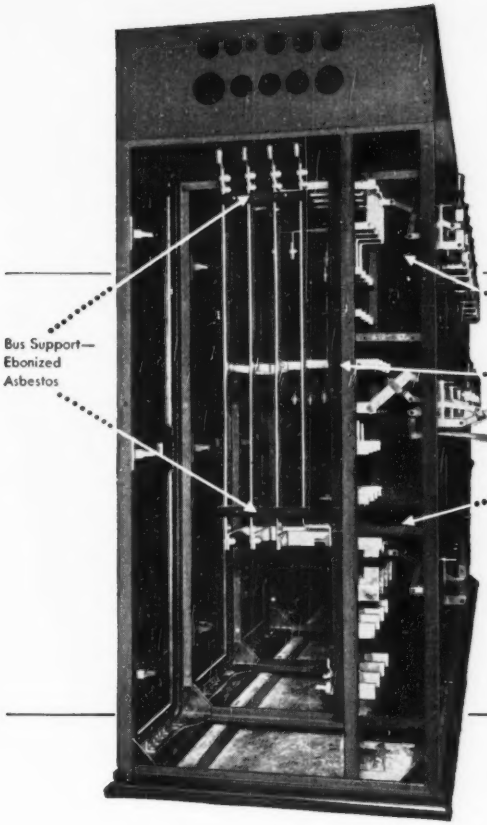
REYNOLDS METALS

REYNOLDS *Lifetime* ALUMINUM

CONSIDER ALUMINUM • CONSULT REYNOLDS • THE COMPLETE ALUMINUM SERVICE

K&M EBONIZED ASBESTOS

for electrical mountings THAT GIVE YOU 3 HIGHS!



In addition to bus supports and mounting panels of K&M Ebonized Asbestos, this Pringle Switchboard has separators of K&M Monobestos—another versatile K&M material that betters electrical equipment.

High dielectric strength, high physical strength and high adaptability, all count in placing Ebonized Asbestos in much of the precise electrical equipment. Precision manufacture under high pressure, using specially developed raw materials, provides a product that can be readily machined, cut and drilled.

Pringle Electrical Manufacturing Company, Philadelphia, applies K&M Ebonized Asbestos to bus supports and mounting panels of the Dead Front Safety Knife Switch illustrated. The electrical safety factor is inherently high per unit of material. So is the mechanical safety factor, because there is strength in all directions with K&M Ebonized Asbestos. It particularly resists shock, vibration and temperature fluctuation.

These characteristics are valued by designers and engineers, for switchboard mountings, bus bar runs, compartment linings, test tables, bench boards and related applications. With K&M Ebonized Asbestos available in thicknesses from 1/8" to 4", any requirements can easily be met. For additional details write us; we'll answer you promptly.

K&M best in asbestos

Nature made Asbestos . . .

Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

In Canada—ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG and VANCOUVER

Preformed? YES!
Bethanized? YES!

FORM-SET STRAND HAS BOTH ADVANTAGES

In recent months a good many users of strand have decided that Bethlehem's Form-Set will do a better job for them. Maybe you've reached that decision yourself. You've investigated Form-Set and learned that its preformed construction makes it easier to handle . . . easier to insert in fittings . . . because, when cut, Form-Set doesn't unravel or "bush out" at the ends. But possibly you haven't thought to ask whether it's available with a bethanized coating.

The answer is yes! In fact, bethanizing is standard on all types, grades, and sizes of Bethlehem strand, both preformed and non-preformed.

The bethanized coating is a smooth, uniform jacket of highly-pure zinc—a coating so ductile that it will bend without cracking. The coating is available in three different weights—A, B, and C—making it possible to protect against atmospheric corrosion in any given area.

Form-Set strand, with the guardian bethanized "armor," well warrants your investigation. We know that it will not disappoint you. However, if there are still some angles you'd like to discuss, a Bethlehem man will be glad to give you further information.

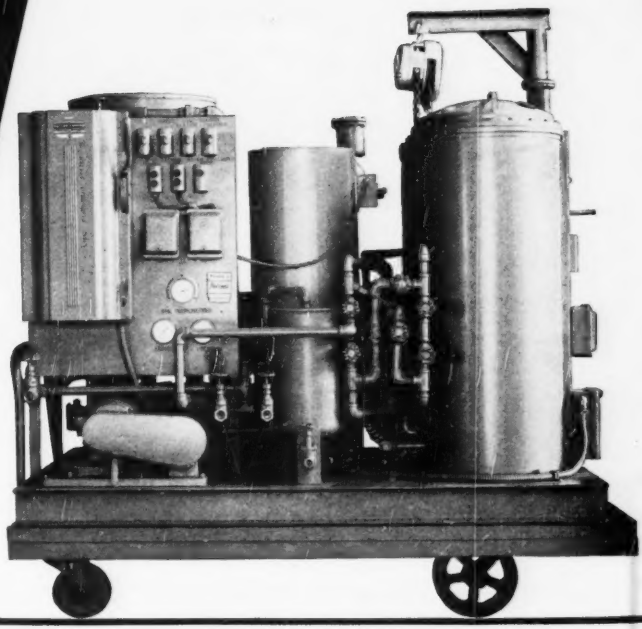
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

Here it is at last...
in One Package!

a COMPLETE SYSTEM for PURIFYING INSULATING OIL

... in the Field or at Central Station



Houdaille* Purivac

Here in one compact unit is a complete purification, dehydrating and degassifying system for insulating oils. The Houdaille PURIVAC can be connected directly to transformer and operated while the transformer is in service or out of service.

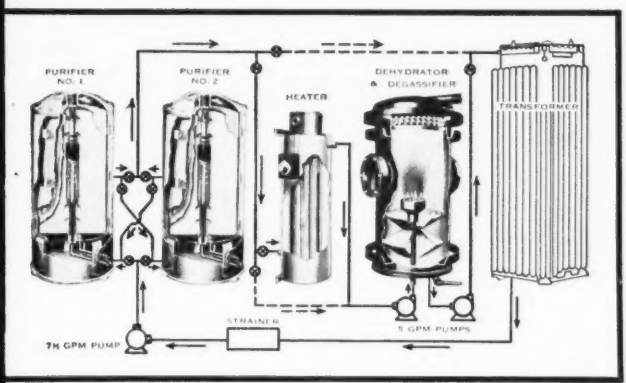
PURIVAC can be set up either in the field or at a central station for equally efficient oil reconditioning performance; serves either above-ground or subway-type transformers.

PURIVAC's dual purifiers can be operated separately, in series or in parallel.

PURIVAC's automatic electric vacuum unit atomizes oil and performs complete dehydration and degassification without need for high surface-temperature heaters or blotter press equipment. Automatic temperature control assures even distribution of heat, efficient system operation.

PURIVAC is engineered to meet the most *exacting* Utility requirements . . . compactly designed and built to serve *all* requirements.

Write or phone now for complete details . . . or, at your request, a Honan-Crane Sales Engineer will call for consultation on your problems.



Flow diagram showing progress of transformer insulating oil through purifying, dehydrating and degassifying units of the new Houdaille PURIVAC. Complete reconditioning of the oil is accomplished by this one compact system.

*Pronounced Hoo-Dye

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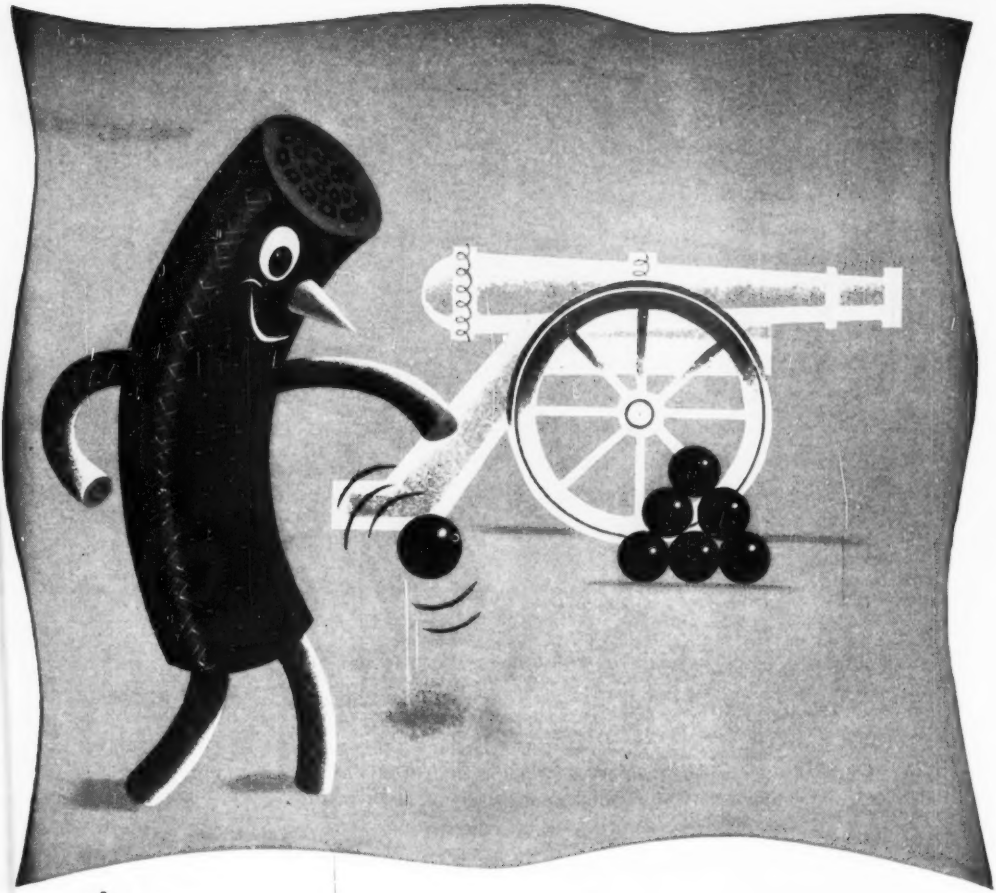

Why we quit making rubber-covered cannon balls

We have made—and quit making—a lot of things during our nearly 100 years in business. Because of our "know-how" in making insulation of unusual durability, we were asked to develop rubber-covered cannon balls to reduce wear-and-tear on cannon, during the war between the states.

It was an interesting job—but the solution to cannon wear was tougher cannon rather than softer cannon balls.

We have retained our "know-how" in making insulation, however—and since those early days, we have made a lot of new developments. We developed the first insulated wire for Samuel Morse's telegraph. We pioneered in submarine cable well before the turn of the century. We even had to develop extruding machinery to apply insulation to wire and cable.

In recent years, Kerite has led in the development of self-supporting aerial cable, high-voltage x-ray cable which no one else could build satisfactorily, and in many other fields.

Kerite insulation—made only by Kerite—provides unusually long life and low cost per year. Why not ask a Kerite engineer to help put it to work for you? *The Kerite Company, 30 Church Street, New York 7, N. Y.*

Offices also at: 122 So. Michigan Avenue, Chicago; 582 Market Street, San Francisco; 714 W. Olympic Blvd., Los Angeles.

Kerite Insulation—Your Cable's Best Life Insurance

KERITE CABLE

Notable Decision

One of the most significant—and courageous—regulatory decisions of the last half decade was the recent Federal Power Commission ruling on hydroelectric development in the Kings River Basin in California. By permitting a municipal body and a privately-owned utility to share in this project, FPC revived a principle of federal and non-federal cooperation which has been dormant since the building of Hoover Dam.

The Army Engineers already were at work on the key Kings River project, Pine Flat Reservoir. The municipal agency, Fresno Irrigation District, and Pacific Gas & Electric Co both sought U. S. licenses to install hydroelectric plants at Pine Flat and other sites.

But FPC's primary concern in the case revolved about the Interior Department's opposition to both applications. Interior argued that construction of the Kings River plants by its own Bureau of Reclamation would best serve the public interest. Taking Interior's "public interest" contention largely at face value, an FPC examiner recommended a decision for federal development.

The Commissioners, themselves, however, took better stock of Interior's claim. They found Interior had submitted to the White House a master plan, with the Kings River projects scheduled as a unit of Reclamation's Central Valley Project. It was Interior's hope that the President would transmit this proposal to Congress with a request for authorization. But the plans bounced back from the White House, and Interior scaled down its Kings River program. Barring further Presidential objections, this revised plan presumably will get to Congress eventually.

That boiled down the matter to choice between a federal agency with a mere yen to build and two non-federal parties with both the will and means to start construction at a definite and early date. With the Bureau's plans "contingent upon many uncertainties," FPC concluded the public interest would not be served by allowing "these water resources to remain idle" until Reclamation tried to remove the "ifs" from its plans.

Thus FPC assured the non-federal portions of the utility industry that they could not be foreclosed from hydroelectric development of major waterways by the mere desire of federal agencies to exploit such resources. As the Commission noted, the "Federal Power Act does not contemplate delay beyond the time when it is economically feasible to provide for construction with the safeguards of the licensing conditions."

This was an assurance the industry sorely needed at this time. FPC soon must deal with a very similar Interior bid to block non-federal development of the Roanoke River in Virginia and North Carolina. As it did in the Kings River case, Interior has claimed federal development of the Roanoke would be "in the public interest." The proceedings have been followed closely by the entire utility industry.

Now, regardless of its ultimate decision on the Roanoke project, FPC has demonstrated that it has both the mental and moral stamina to make its own determination of the public interest in such cases.

EEG Needs Help

FEW ELECTRICAL engineers appreciate the fact, but it seems definitely certain that electro-physiologists will lean heavily on electro technology in studying the human brain to find out how it works normally and what makes it work abnormally. The art is called electro-encephalography and the primary tool is the oscillograph. The alphabetical shorthand for it is EEG.

Electrodes applied to the scalp reflect the currents in the nerves when the cells send messages to one another. The traces on the oscillograph are more complex and erratic as to frequency and amplitude than anything the electrical engineer customarily encounters in his films. Nevertheless the welter of harmonics that comprise these jumpy jiggles undoubtedly mean something if sorted out. Some work has been done to submit the waves to Fourier analysis, but plenty is to be done.

Meanwhile the electro-physiologists have concocted a jargon all their own. They recognize "alpha" rhythms of 8 to 13 cps as associated with occipital activity prompted by visual impressions, the eyes open. They have dubbed the 6-cycle vibrations of an unhappy or angry child as "theta" rhythms. Brain disease is typified by slow discharges called "delta." There are also "spikes" when the subject is unconscious—this superactivity is viewed as a brain "electrocuting itself." A multiplicity of cathode-ray tubes used simultaneously can, of course, register what goes on simultaneously at as many areas of the brain, but they tend to confuse the interpretation.

Here is an art manifestly needing the talents of electrical and electronic engineers if only to improve the terminology, run down the harmonics, trace the feed back factors, and help interpret the phenomena in terms of electric circuit counterparts.

When electro-encephalography transcends the pursuit of tumors and lesions in the search for the manner in which the good mind carries on its ideation it becomes a part of what has been called cybernetics. Electrical engineers are destined to play a large role in the unraveling of that most mysterious machine—the human brain.

Time for Cooperation

AFTER MANY months of hard work, the National Committee for Utilities Radio secured from FCC an allocation of the channels for the industry's mobile radio requirements. Following the assignment of zone frequencies by FCC, the regional committees of the NCUR made up frequency allocation patterns in conformity with the overall plan. This involved very detailed studies of areas covered by various utility systems, their proximity to others, and the corresponding danger of interference.

This program for regional frequency coordination led to a recommended channel for each system. If one utility fails to adopt the frequency proposed by the committee, the whole pattern may be upset. Such adoption of the channel may also require substantial expense for change-over. But these are the necessary elements in protecting all interests in the two-way radio communication field.

Cooperation on the part of the electric utilities is almost unanimous now, but the goal is 100% acceptance.

Free Enterprise

AN ATTRACTIVE BOOKLET entitled *Barbadoes*, describing the generating station of that name, is being distributed by the Philadelphia Electric Co. The 16 pages devoted to this power plant are not of the usual statistical nature. In fact, few of the elements are presented in other than round figures which give an idea of the size of the project. Historical background, colored illustrative sketches, human relations, and the major problems of power supply receive most emphasis.

Tucked away in a not inconspicuous corner is a further reflection of the breadth of this little booklet. Here is found a paragraph headed "Free Enterprise," which is quoted as follows:

"The enlargement of Barbadoes station and other construction work Philadelphia Electric now has under way are outstanding examples of the Free Enterprise System at work. They are typical of electric light and power industry expansion programs throughout the nation. Each of these major projects is a closeup view of the individual effort and the private capital that founded the electric industry and made possible its growth, its development, and its far-reaching service to mankind."

This effective reminder of the true character of the industry's activities is worth repeating many times.

Seminar for Engineering Faculty

THE CLEVELAND ELECTRIC Illuminating Co found out a few years ago that the electric utility industry was not even being considered as a career by many of the most promising college men. It appeared from the survey that graduates felt salaries were too low, companies did not offer training programs, opportunities were too limited, and the industry offered too many of the disadvantages of Civil Service.

These adverse conditions have been overcome to a substantial degree even though much is yet to be done. Realizing that such improvements may not be recognized, CEI officials decided to reach the students by telling the industry's story to the college faculty. They developed a three-day seminar on operations of their company and the opportunities for college graduates.

As would be expected, the reaction to this experiment was excellent. Such is always the case when employees, customers, or the public are given the facts about this great industry. Here then is another field of activity to add to the rising tide toward a continuous open house by electric utilities for those they serve.

The Electrical Week

Electric utility company profits will be at least 11.6% higher this year than in 1948. A study by ELECTRICAL WORLD revealed these causes: greater sales, lower fuel costs, and more efficient equipment . . . The Atomic Energy Commission has let the contract for the first "breeder" pile, a necessity if atomic energy is ever to be used to produce electric power . . . Loans to cooperatives by REA will aid the Southwestern Power Administration to secure use of over 800 miles of transmission lines . . . And at Philadelphia where the CIO is organizing its new, anti-Communist International Union of Electrical, Radio & Machine Workers, the delegates, looking ahead to huge demands by utilities for electrical equipment, are seeking pensions, social insurance, and pay boosts.

Remember when the utility industry drew screams from Washington do-gooders for alleged propagandizing of school teachers, pastors, and their local press? Well, that's exactly what the Rural Electrification Administration in an "educational" handbook, "Telling the Co-op Power Story," advises its electric co-ops to do—propagandize teachers, etc.

In Pomona, N. C., where some 168 homes have been purchased from a defunct textile company, the new owners, many of whom have lived in their homes for years, were surprised by a statement of a county electrical inspector that their house wiring is substandard and defective. The home owners have not had any trouble with the wiring, but the inspector cannot approve the wiring until it conforms to state standards. Duke Power won't connect until the inspector approves. It is reported that the inspector has a headache.

The coal miners were back at work. In the week ended Nov 19 they mined 14 million tons, the highest week recorded since April, 1948.

Can anyone in the industry supply ELECTRICAL WORLD with the number of salesmen selling Adequate Wiring on a door-to-door basis? EW editors guess that the figure is zero.

Bridgeport, Conn., observed "Charles E. Wilson Day" on Nov 28. Among the honors conferred on General Electric Co's president by the town in which he lived for 18 years was an honorary master of science degree from the University of Bridgeport. It was the first such award by the three-year-old university.

The right or East Powerhouse at Grand Coulee Dam will be colorful if nothing else. The control bay floors will be varigated red, the visitors' gallery tunnel will be gray-green with green glass walls, the generator room will have a maroon floor, the generators will have three alternating stripes—two black, one greenish cream—the governor gallery floor will be a combination of green, gray, and black. Most of the floors will be terrazzo.

The fly-ash being used in the construction of the Bureau of Reclamation's Hungry Horse Dam in Montana is coming from the plants of a business-managed utility, Commonwealth Edison Co, Chicago. The fly-ash is mixed with the concrete, and its use will save the taxpayers some $5 million.

Streamlined accounting methods for the Bureau of Reclamation's $400-million water program are being studied by Bureau officials. Suggestions for snipping red tape will be submitted to the General Accounting Office, Bureau of the Budget, and the Treasury Department.

"Pure bunk" is the label tacked by the Hartford Electric Light Co to reports that TVA has dragged industries from New England because of differentials in power rates. That's one of the points in a concise, down-to-earth booklet on public power propaganda prepared by the company for its employees.

Notes From The News

Idaho Power Co and Utah Power & Light Co will have enough capacity and transmission facilities to serve AEC's reactor plant at Arco, Idaho. The former will run a line to Arco from its American Falls plant, the latter from the Goshen substation near Idaho Falls . . . Recent heavy rains in the Northwest meant floods and a boost in water supplies which will do much to block power shortages later . . . Dallas Power & Light Co has paid Dallas $163,488.85 in franchise taxes for the third quarter of the year, the largest sum it has ever paid for any quarter . . . The Ohio Public Utilities Commission has suspended temporarily the 27% cut in electric rates of the Columbus & Southern Ohio Electric Co which Columbus citizens voted themselves on Nov 8 and for which city officials are still fighting.

Electric Utility Profits Higher in 1949

ELECTRICAL WORLD Study Based on First 9 Months of Year Indicates Rise of 11.6% over 1948; Lower Fuel Prices, More Efficient Equipment Help

ELECTRIC UTILITY profits for 1949 probably will be at least 11.6% higher than in 1948.

Combined net income for the privately owned electric power companies is expected to be about $732,792,000 this year. These figures were projected by ELECTRICAL WORLD on the basis of reports for the first nine months and conservative estimates for the remaining quarter.

Heavy allowance was made for effects of the coal and steel strikes. If those effects prove to have been overestimated, profits will be even higher.

Gross Income to Rise 11.2%

ELECTRICAL WORLD's projected 1949 totals (See lower table) call for a combined electric utility gross income of $996,109,000, or 11.2% above 1948. Total electric operating revenues are predicted to be $4,374,135,000, or almost 5% over last year, and electric operating revenue deductions $3,499,047,000, or 3.3% over 1948.

Figures reported by Federal Power Commission for the first nine months of 1949, before the coal and steel strikes, show a much bigger jump. For the three quarters (September figures are preliminary ones) net income was $557,792,000, more than 15% above 1948. Operating revenues were $3,254,135,000, up more than 6%; revenue deductions $2,594,047,000, up almost 4.5%; and gross income $753,109,000, up almost 14% from the first nine months of last year.

Third Quarter Trend Upward

Continued through the third quarter was the upward trend established in the first half of this year, when the nation's electric companies reported record earnings of $391 million, or 13% above the corresponding period of 1948.

Since last March monthly FPC figures have shown net income increasing much faster than operating revenues. In August revenues were up 5.1% and net income 19.1% over August, 1948; in September revenues rose 2.7% and net income 17.1%.

Financial positions of individual companies for the first nine months, however, varied widely. Ten sample companies (See upper table), including six of the nation's largest in terms of customers served, all made higher profits than for the corresponding period of 1948. The increase in net income ranged from less than 1% for West Penn Power Co to more than 80% for New England Power Co.

Electric Utility Net Incomes Are Rising in 1949

Company	First 9 Months 1949 Operating Revenues	First 9 Months 1949 Net Income	First 9 Months 1948 Operating Revenues	First 9 Months 1948 Net Income
Commonwealth Edison Co	$184,397,800*	$21,888,181	$175,001,881*	$18,135,273
Consumers Power Co.	68,538,303*	11,493,798	64,039,267*	10,667,860
Northern States Power Co. (Minn.) (consolidated)	56,804,264	9,874,247	50,292,199	7,284,766
Georgia Power Co.	51,894,577*	7,411,116	48,339,356*	5,238,720
Buffalo Niagara Electric Corp.	44,376,707	6,309,955	43,208,318	3,965,949
Alabama Power Co.	33,751,561*	6,649,740	33,042,252*	4,888,973
New England Power Co	23,911,449	3,114,462	20,594,957	1,714,414
West Penn Power Co	33,034,196	6,638,733	31,609,512	6,576,372
Public Service Co of Colorado	28,010,844	4,687,420	24,283,653	3,854,181
Oklahoma Gas & Electric Co	18,055,355	3,965,754	16,691,901	3,058,065

*Consumers Power Co, Georgia Power Co, and Alabama Power Co report only gross earnings, Commonwealth Edison Co reports total revenues.

Class A and B Electric Utilities

	Total Electric Operating Revenues	Total Electric Operating Revenue Deductions	Gross Income	Net Income
1949 (est.)	$4,374,135,000	$3,499,047,000	$996,109,000	$732,792,000
1948	4,167,285,158	3,388,111,690	895,551,231	656,808,171

Source: Federal Power Commission figures

Probably the biggest single factor in the improved profit picture was a sharp drop in fuel costs. Total fuel costs for the first eight months of 1949 were almost 6% below the corresponding period of 1948, with sharpest declines after midyear. Part of this drop resulted from lower unit costs, part from increased use of hydro facilities for generation.

Unit costs have been cut by installation of more efficient generating equipment, increased use of low-cost natural gas, and lower coal and oil prices. Better water conditions have helped hydro generation. For 1949 utilities are expected to produce 1 kwhr of power from 1.2 lb of coal or its equivalent, compared with an industry average of 1.3 lb a year ago.

Rate increases also have helped some companies boost their earnings. On a nationwide average rates have risen about 2% in the last year and a half after the greater decline of the past 20 years came to an abrupt end.

Rising sales to domestic and rural customers, the industry's most profitable customers, also have brightened the profit picture. This trend is expected to continue through the last quarter, partly offsetting a strike-induced major drop in industrial sales.

Total energy sales for the first nine months were up about 2.4% (September totals estimated), from $186,090,000 for the first three quarters of 1948 to an estimated $190,489,000 for the same period this year.

Stockholders, employees, and governmental units are sharing the industry's higher earnings. Figures for the first six months of 1949, latest published by Federal Power Commission, show an 8.7% rise in total dividends over the same period of 1948 and a 10.2% increase in common dividends. Part of this resulted from the larger number of shares outstanding, but many companies have upped their dividend rates. Salaries and wages climbed 7.9% for the first six months, partly as a result of rising employment. Taxes were up 13.2%. The federal government collected 14.9% more and state and local governments, 11.1%.

U. S. Lets Contract for 'Breeder' Pile, Key to Non-Military Atomic Power

REASSURANCE THAT the U. S. is forging ahead with exploitation of the peacetime potential of atomic energy came this week from the Atomic Energy Commission. In a unique and timely announcement Nov 8, AEC reported new steps toward development of nuclear reactors for non-military purposes, including piles for the production of electric power.

Most important item in AEC's "progress report"—its first since word that Russia had the bomb—was an announcement of a contract for construction of the world's first "breeder" reactor.

Breeder Is Economic Key

A "breeder" pile is one which, by burning fissionable uranium, transmutes non-fissionable uranium into plutonium in greater quantity than the uranium it consumes. Such a reactor—hitherto only a theoretical possibility—is essential to civilian use of atomic energy. By eliminating the fuel supply factor, it will put atomic energy on a more economically competitive basis with orthodox sources of power. Otherwise, the cost of atomic energy installations rules them out for most conceivable civilian uses.

A "breeder" pile also would be of considerable significance in AEC's atomic weapons program, removing to a considerable degree this country's dependence on foreign sources of uranium.

Operation to Begin in 1952

Construction of the reactor, at AEC's new testing station near Arco, Idaho, will take about a year. It will be some months thereafter—sometime in 1952—before actual operation of the reactor will show whether "breeding" of fissionable material is actually possible. It has been theoretically demonstrated by nuclear physicists since the atom bomb was first produced.

Bechtel Corp of San Francisco will build the housing for the Arco pile under a $2.5-million contract. The uranium pile itself will be furnished by the Argonne National Laboratory, where it is being designed and built at a cost of around $1 million.

AEC officials said this first "breeder" pile is expected to produce only a little more fissionable material than it consumes. But, they added, the design is the first attempt at the job, and from experience gained through its operation it is expected future "breeder" piles of greater efficiency will be built. Theoretically, it is possible to produce 140 times as much fissionable material as the amount of fissionable uranium used to start with.

"Breeding" of atomic fuel is a major goal both for bomb production and for successful atomic power production. With a "breeder" pile, the end product plutonium could be extracted in greater quantity than now as material for bombs, or, in a power pile, could become additional fuel for generating more energy. An "incidental amount of electric power may be produced as a byproduct" of the first "breeder," AEC said.

The progress report on the $3.5-million "breeder" pile overshadowed announcement of a new time-table for three other atom furnaces:

1. Electric power producing reactor, planned for the Knolls Atomic Power Laboratory near Schenectady, N. Y., is in the engineering design stage, but construction of major facilities at the Knolls site is slated to get underway next spring. Known as the intermediate reactor, it will be another "breeder." Heat from the reactor will be removed by means of liquid metal; the heat will produce electric power through conventional generators. Cost of the first atomic electric plant will range from $25 million to $40 million.

2. A materials testing reactor will be built at the Idaho site; construction will begin next spring. With this reactor scientists will try to find materials with which they can build atomic energy plants. Biggest problem for study with this atomic furnace: How to build atom plants to power planes. Cost of the reactor is estimated at $25 million.

3. A ship propulsion reactor will be under construction near Pittsburgh by 1952. Total cost will be at least $25 million, with $6 million already contracted to Westinghouse Electric Corp.

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Cities Free to Buy Plants

Kentucky cities do not have to obtain the approval of the Public Service Commission to buy utility plants, according to an opinion by Assistant Attorney General J. G. Ashcraft. He said the law provides that cities must gain approval to construct utility plants but not to purchase them.

STORMY PETREL David E. Lilienthal closes a hectic government career Dec 31 when his resignation as chairman of the Atomic Energy Commission becomes effective. But, he told reporters, he'll have plenty to say about atoms and other public issues as a private citizen. As head of AEC and, previously, as chairman of the Tennessee Valley Authority, he was a center of controversy. His resignation followed one major Congressional debate, may have put a damper on another. A joint committee last summer okayed his AEC policies, but a similar Capitol row is expected next year when all AEC terms expire.

2 New Equipment Items Introduced at Chem Show

Introduced at the 22nd Exposition of Chemical Industries held in New York City this week were a laboratory model voltage regulator and characterized valve positioners suitable for central station control.

The electronic, automatic voltage regulator, rated at 0.25 kva and 115-v output, was shown by Superior Electric Co. This unit is said to produce an instantaneous stable output within 0.1 of 1% of rated voltage, with waveform distortion not exceeding 3%. It is designed to compensate for both line and load fluctuations.

A family of air-actuated, cam-operated valve positioners were exhibited by Bailey Meter Co. These positioners provide operating characteristics such as square root, square and straight line functions for the opening and closing of valves.

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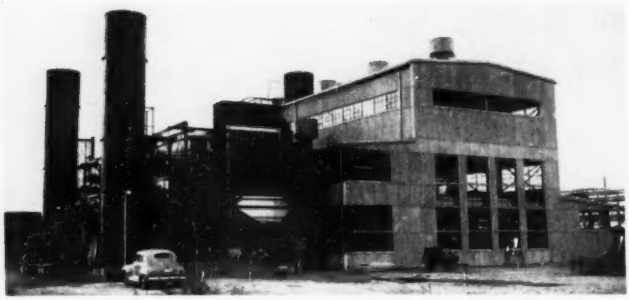
2 Franchises Granted

Colorado Central Power Co has been granted 25-year franchises by Milliken and Johnstown to replace franchises which would not have expired for a few more years.



SECOND 11,500-kva unit has been installed in the Tucson Plant of Tucson (Ariz.) Gas, Electric Light & Power Co. The unit was originally intended for Mexico City, but Westinghouse Electric sent it to Tucson when Mexicans were unable to accept delivery

SPA to Profit from Lines Erected by 2 Cooperatives with REA Loans

SOUTHWESTERN POWER Administration, which received funds for transmission lines only after heated Senate debate in the first session of the 81st Congress, may get more than 800 miles of transmission line constructed with Rural Electrification Administration funds under loans approved by REA last week.

Greater part of more than $15 million in REA loans will finance the lines for two borrowers in Central Missouri. The lines, which will carry power from two new federal dams in northern Arkansas, will be operated and may be purchased by SPA. Under long-term lease agreements, the federal power marketing agency will pay a rental on the new lines sufficient to amortize the 2% REA loans in 35 years.

SPA can lease and operate the lines under its present authority granted by Congress. To take title to the lines, 35 years hence or sooner, the agency would probably have to get additional authority from Congress.

A new super co-op, Central Electric Power Cooperative, Linn, Mo., received a loan of $11,350,000 for construction of 465 miles of lines to deliver 70,000 kw from Bull Shoals Dam starting in 1953. In addition, the co-op will construct a 15,000-kw steam generating plant on the Missouri River near Jefferson City. Output will be purchased by SPA to firm up power on the 182 miles of 154-kv line which will connect the new plant with Bull Shoals. Distribution of power to six members of Central will be made on 289 miles of 69-kv line.

One of the members, Sho-Me Power Corp, Marshfield, Mo., was approved for an additional loan of $2 million. This, plus an earlier loan to Sho-Me of $2,159,500, will be used to construct 371 miles of 69-kv line. This new Sho-Me system will tie in with lines bringing 7,000 kw from Norfolk Dam under a similar arrangement with SPA, it was announced by REA. Norfolk's 7,000 kw will be available within a few months. Sho-Me is affiliated with 10 distribution co-ops in central Missouri.

In announcing the Missouri loans, REA said that studies indicated the new program should save the co-ops about 50% under present power bills and give new assurance of adequate and dependable power supplies.

The new Central Co-op is the fourth of its type in Missouri, and a fifth, the N.W. Power Cooperative of Savannah, is reported to be seeking an $11-million loan to serve seven member co-ops in the northwestern part of the state. This loan has been opposed in a statement to REA by five power companies in the area.

In another near-record loan last week, REA approved a grant of $10,265,000 to the East Kentucky Rural Electric Cooperative Corporation of Danville, Ky. This, plus an earlier loan of $2 million made in 1941, is planned to finance construction of a 40,000-kw steam plant at Ford, Ky., and a network of 597 miles of transmission lines. The new loan must be approved by the Kentucky Public Service Commission.

The 69-kv line will interconnect with TVA's system so that east Kentucky can firm up its power or purchase secondary power from the federal agency. TVA, on the other hand, will purchase any surplus power generated by the co-op.

Short power supply and high wholesale power rates charged by commercial utilities were cited by REA in approving the Kentucky loan.

Only larger single REA loan than the Central Electric and East Kentucky loans was $14.3 million to Virginia's Old Dominion Co-op in September. This loan has not yet received approval from the Virginia Corporation Commission.

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Northwest Power Supply Better Than Year Ago

The power situation in the Pacific Northwest, although improved somewhat in recent weeks to a point where it is considerably brighter than a year ago, is still delicate, members of the Northwest Utilities Conference Committee agreed at a meeting in Tacoma.

The margin between supply and demand is narrow and will continue so throughout the winter, committee members declared. Prolonged cold weather could produce a power shortage worse than last year.

On the favorable side, power demands have increased only slightly over those of a year ago; interruptible power to the aluminum plants was cut off earlier than last year, leaving more electricity for the general pool; private companies are getting 30,000 kw from British Columbia; new Bonneville Power Administration lines from Grand Coulee Dam to Snohomish and into the Olympic Peninsula provide more flexibility in transmission; and fuel oil is cheaper and more abundant.

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Navy Power Train Hired for Use in Mexico City

A 10,000-kw U. S. Navy railroad power plant left Philadelphia Nov 25 for Mexico City, where it will help relieve a power shortage caused by drought.

Delivered to the Mexican Light & Power Co at Philadelphia, the four-car power unit is being leased at a rate of $400 per day. The equipment, which has been adapted to operate at the Mexican standard of 50 cycles as well as 60 cycles, was sent to Mexico once before during a critical electric power shortage in Colaya, Mexico, during 1947-1948.

The train is one of two railway-mounted power plants which the Navy operates. The second is at Mare Island, Calif.

THE 100th ADEQUATE WIRING CERTIFICATE issued by the Central Wisconsin Adequate Wiring Bureau is presented to Mr and Mrs Ray Soderberg (right), Beloit, by T. E. Hayhurst, Beloit electrical inspector. Soderberg has wired four other certified houses

IUE-CIO Wants Economic Gains, Cites Market for Utility Equipment

THE FAVORABLE impact of electrical generating capacity expansion on the electrical equipment business is one of several reasons cited by the new CIO International Union of Electrical, Radio & Machine Workers for its three-point, fourth-round wage demands on manufacturers.

The demands include a new wage increase to correct "inequities" and compensate for increased worker productivity as well as employer-financed pensions and social insurance. (Other CIO unions have foregone wage increases this year in return for pensions.)

James B. Carey, chairman of the IUE-CIO, attempted to justify the demands in a 16-page "Economic Report" on the electrical manufacturing industry submitted to the IUE-CIO organizational convention at Philadelphia this week.

The three economic demands are for:

1. Employer-financed pensions of a "minimum" of $100 a month, including social security. This demand differs from existing plans in steel and at Ford in that any increase in social security benefits would be added and not result in employer savings. Also, IUE-CIO wants employer contributions to accrue for the worker so that the amount paid into his pension account can be taken with him when he is severed from his job.

2. Social insurance covering death, disability, hospitalization, surgery, pregnancy, sickness, and medical care. (IUE cites the steel fact-finding panel's recommendations that this be employer-financed, but ignores the fact that the steel union settled for a contributory insurance plan.)

3. A wage increase to compensate for inequities and increased productivity and "partly close the sizeable gap" between average wages in the electrical industry and those in automobile, steel, transportation equipment, aircraft, and railroad equipment. (Electrical industry average wage is given as $1.44 for September, compared with an average of $1.48 for all durable goods.)

Carey's report covers the profit and productivity situation in the industry as well as the business outlook.

Profits after taxes are given as $575 million in 1948 compared with $430 million in 1944 and $148 million in 1939. Productivity in 1947 is cited as 30% above 1943.

Citing ELECTRICAL WORLD's forecasts last Jan 29 on generating capacity expansion of the utility industry in 1949, 1950, and 1951, Carey's report asserts:

"This tremendous expansion * * * will provide a tremendous market for the products of the electrical machinery and equipment industry, just as the extension of electrical power to hundreds of thousands of additional homes and the increased usage of electric power by householders, farms, commercial, and industrial users promises huge increases in the sales of electrical appliances and electrically powered equipment."

IUE-CIO's approach on the wage question will be "realistic" and take into account a company's ability to pay, historical pay differentials, "and all other pertinent factors," according to Carey.

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GE Revises Construction, Design Setup at Hanford

General Electric's design and construction divisions at Hanford Works, Richland, Wash., have been reorganized into three separate line divisions—Power and Mechanics, headed by Division Manager J. R. Kelly; Separations, headed by E. W. Seckendorff; and Reactor, P. E. Lowe.

The Power and Mechanics Division is responsible for project management and engineering on assigned projects in the non-process field. It also will provide civil, mechanical, electrical, and architectural engineering services for the other divisions, as well as drafting and blue-printing, planning, and estimating.

The Separations Division will carry out mechanical design and development of process equipment, as well as construction design, engineering, and project management in assigned projects in the field of chemical separations.

The Reactor Division is responsible for mechanical design and development of nuclear reactor and related process equipment and construction design, engineering, and project management on assigned projects in the field of nuclear reactors.

Hanford Works, operated by General Electric for the Atomic Energy Commission, is the only plant in the United States manufacturing plutonium on an industrial scale.

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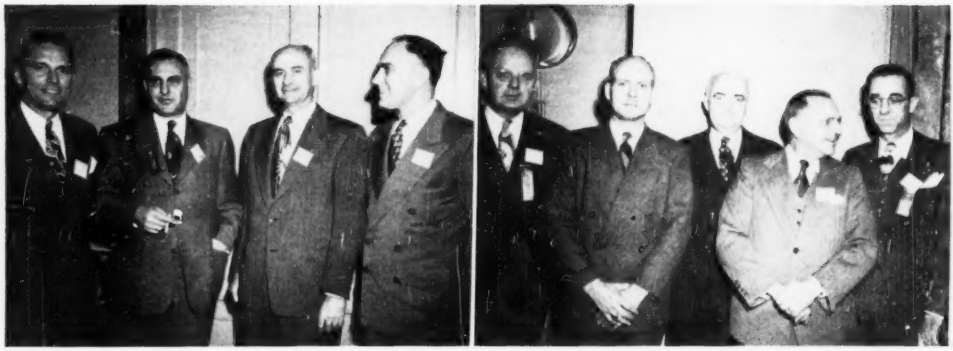
Grant Florida Franchises

Thirty-year franchises have been granted Florida Power & Light Co by three Florida cities. The agreements approved by Fort Lauderdale, Fort Myers, and Port Orange provide that the company will pay each city a 6% yearly rebate on electricity sold to residential and commercial users. City taxes will be deducted from this amount. Edgewater voted to ask the utility to furnish it with service.



SECTION OFFICERS elected by the Wisconsin Utilities Association are, left to right, C. J. Forsberg, Wisconsin Power & Light Co, vice-chairman, and E. W. Deterling, Northern States Power Co, chairman, of the Electric Section, Technical Division; and J. D. Howard, Wisconsin Power & Light Co, chairman, and William H. Wagner, Wisconsin Electric Power Co, vice-chairman, Electric Section, Sales and Service Division. In right panel, left to right, are program participants: A. G. Pergande, Wisconsin Electric Power Co; Prof H. A. Peterson, University of Wisconsin; M. S. Oldacre, Commonwealth Edison Co, Chicago; H. H. Brown and J. S. Wells, Wisconsin Michigan Power Co

Convention Program of Wisconsin Utilities Association Is Diversified

A VARIED PROGRAM dealing with technical, operating, sales, and public relations problems was presented, Nov 21-23, at the convention of the Wisconsin Utilities Association. The meeting at Milwaukee was attended by over 500 members and guests.

Connection of 5,500 watts of lighting in the "Sunshine" home is the industry objective through today's Planned Lighting program, said H. H. Green of General Electric. He outlined growth of the business, pointing out that in 1925 the objective was 1,800 watts in the "well lighted" home. He said that active utility leadership is essential if the new objective is to be realized.

Dancing conductors came in for much attention. M. S. Oldacre, Commonwealth Edison, Chicago, discussed experiments his company has been conducting and showed two films where sleet conditions were simulated on a test line. Effects of wind at different velocities attracted considerable interest.

A film showing galloping because of magnetic effects of heavy currents caused by short circuits was shown by L. P. Works, distribution superintendent, Wisconsin Public Service Corp. He conducted extensive tests, and the movies, in extreme conditions, showed conductors wrapping completely around each other several times.

"Federal income tax structure is such that the investment in equity capital is substantially discouraged." John C. Doerfer, chairman, Wisconsin Public Service Commission, told the convention. He said that this fact, together with the tendency for utility revenues to level off while cost of operation still increases, makes the problem of financing future expansion a very acute one.

"Another problem which is of great concern to the commissioner," Doerfer claimed, "is the present tendency of the federal government to arrogate to itself the power to regulate purely local affairs. If this development continues unchecked, we may soon find the states existing by favor of some administrative department of the federal government."

Average retail market for appliances is about $150 per farm customer, according to a survey reported to the convention by W. J. Ridout, Jr., rural service manager, Edison Electric Institute. This would mean a market of three quarters of a billion dollars for electrical equipment among farmers now using electric service. Figures were obtained through interviews with 2,377 farm customers in 19 states.

E. W. Deterling, Northern States Power Co, was elected chairman, and Carl J. Forsberg, Wisconsin Power & Light Co, vice-chairman of the Electric Technical Division. J. D. Howard, Wisconsin P&L, will be chairman of the Sales and Service Division.

PROF EDWARD BENNETT, right, who retired after 40 years on the staff of the University of Wisconsin, receives a WUA citation for service from G. W. Van Der Zee, left, president of Wisconsin Electric Service Co. Carl A. Altenbern, WUA president, is in center

REELECTED OFFICERS of the New Jersey Utilities Association are, left to right, Howard H. Melvin, secretary; Bayard L. England, vice-president; and Albert C. Goebel, treasurer. President Franklyn Heydecke was also reelected but was absent when picture was taken

More Sales Power Needed, New Jersey Utilities Association Told

MORE SALES POWER is necessary to get a free competitive economy moving upward, W. J. O'Brien, general sales manager of General Electric Co. warned the New Jersey Utilities Association at its meeting at Absecon.

Other speakers at the meeting, Nov 18 and 19, were W. C. Johnson, executive vice-president, Allis-Chalmers Manufacturing Co, who gave an off-the-record discussion of the political threat of unions, and L. J. Rauh, assistant manager, Department of Customers' Accounts, Consolidated Gas, Electric Light & Power Co of Baltimore, who spoke on credit and collections.

Going further into the problem of sales promotion, O'Brien made the following significant statements:

"Recently, I heard of a utility that had caught up with its demands and was saying it would be happy with a normal load growth of some 3% per year. That, to my way of thinking, is sticking your head in the sand and letting many opportunities pass by.

"I assure you that we in the manufacturing business will not let that go on. We are out to sell new equipment and plant modernization so that utilities will have to accept more than a mere 3% annual increase."

L. J. Rauh pointed out that most companies are witnessing a decided upturn in accounts receivable outstanding balances. He also stated that CGEL&P Co's experience is that active account balances are up, but that the company is comparatively better off than was expected. On the other hand, discontinued account balances are pointing in the direction of higher losses. He stated that 65% of the accounts finally deemed to be uncollectable fall into two groups —First, those of customers using service less than 60 days, and, second, inactive accounts for amounts less than $5. About two thirds of the amounts charged to uncollectable covered accounts in service less than 3 years, he said. The method used in reducing collection costs, in which CGEL&P has a very fine record, is to reduce drastically collectors' calls. They are down to 10% of those made in 1939.

Charles A. Eaton, Congressman from the Fifth New Jersey District, presented a strong appeal for individual efforts in the fight to save free enterprise. He called upon everyone to stand up and be counted, saying, "The only hope arises from the countless millions of men who can get together and see that our heritage of freedom is maintained." Climaxing the ovation which Eaton received was a resolution by the Association praising his fine record as a Congressman.

All principal officers were reelected. They are Franklyn Heydecke, comptroller, Public Service Electric & Gas Co., president; Bayard L. England, president, Atlantic City Electric Co, vice-president; Albert C. Goebel, secretary-treasurer, Atlantic City Electric Co, treasurer; and Howard H. Melvin, executive vice-president, Millville Electric Light Co, secretary.

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NLRB Asks Reversal of Supervisor Definition

NLRB has asked the Supreme Court to reverse the decision of the U. S. Circuit Court of Appeals at Cincinnati which held that "control operators" of the Ohio Power Co who direct other workers only in emergency situations are "supervisors" excluded from the Taft-Hartley law's protection.

Particularly objectionable to NLRB are the lower court's findings that:

1. An employee need only possess the "power" to supervise in order to meet the test of a supervisor, and

2. Taft-Hartley's definition is "clear" and does not need clarification by resort to legislative history on that point.

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Utility to Take Over

Franklin, N. J., voters have approved sale of the town's electric distribution system to the New Jersey Power & Light Co for $103,400. This is the last municipal operating in the territory of the company. The New Jersey Zinc Co, which has been serving the town, is no longer able to supply its needs.

SCALE MODELS are being used by the Jersey Central Power & Light Co in safety conferences. Here John O. Leslie, Gilbert Associates, sets up an accident situation for group study

Earnings Lagging, Miller Warns Power Industry

Electric utility earnings have not kept pace with plant investment since 1946, Harry Miller, president of the National Association of Railroad and Utility Commissioners, told the New York Society of Security Analysts recently.

Gross revenues in this period increased by $4.4 million, while plant investment rose $2,800 million over the same three-year interval, he said. Electric utility earnings in 1948 were 11% of gross revenues, compared to 13.8% in 1946.

Miller accused federal agencies of encroaching on the rate making and other functions of state utility commissions. He recommended that the federal commissions be limited in their jurisdiction to regulation of utilities in interstate commerce.

FINANCIAL BRIEFS

Long Island Lighting Co's amended plan for consolidation with its two subsidiaries has been approved by Securities and Exchange Commission, which applied to the U. S. District Court in Brooklyn for an enforcement order.

Rochester Gas & Electric Corp has received FPC's okay to issue 132,000 shares of common stock, from which it expects to realize not less than $3.6 million. Rights are being offered to common stockholders at one for seven.

Middle West Corp is selling to Canadian interests 330,740 shares of common stock of Middle West Utillities of Canada, Ltd. Price is $7,325,000 in United States funds. The sale is expected to be completed about Dec 7.

Kansas City Power & Light Co plans to sell $10.5 million of additional common stock and $20 million of funded securities to help finance its $55-million expansion program. Under present plans $5 million of common would be sold this year and the remainder in 1951.

Loup River Public Power District has sold to underwriters $14.7 million in electric revenue bonds. Proceeds will be used to refund outstanding bonded indebtedness and to make improvements to the electric power system.

Public Service Co of Indiana has received Public Service Commission permission to sell $14 million of convertible preferred stock. It plans to sell about 140,000 shares of $100-par 4's at competitive bidding early this month, offering the new stock to common stockholders at 1 for 20. The stock would be convertible into four shares of common for each of preferred before June 30, 1951, and with $10 per preferred share between then and Jan 1, 1953.

SEC RULINGS

Northern States Power Co, Minneapolis, has been authorized to make an additional common stock investment in Northern States Power Co (Wisconsin), Eau Claire operating subsidiary. The proposal calls for purchase of 15,000 additional shares of the $100-par common stock of the subsidiary to be used for property additions and betterments (Release No. 9470).

Green Mountain Power Corp, Montpelier, Vt., has been granted an indefinite postponement "subject to the call of the Commission" of the hearing on that company's plan for reorganization and redistribution of voting power among security holders. The plan had been scheduled for hearing on Nov 15 (Release No. 9474).

A United Corp common stockholder, Randolph Phillips, has been denied a rehearing on that company's plan for a special capital dividend distribution of 1/10 share of common stock of Niagara Hudson Power Corp for each share of United common, approved by the Commission Oct 20 (Release No. 9477).

New England Electric System, Boston, has received authorization to offer for sale at competitive bidding 669,508 additional shares of its $1-par common stock. Stockholders are to be given prior subscription rights on the basis of 1 for 10. The price to stockholders will be the same as the price at which underwriters will acquire unsubscribed shares. Proceeds will be applied to the construction programs of subsidiary companies (Release No. 9479).

Missouri Power & Light Co, Jefferson City, has received authorization to issue and sell at competitive bidding 20,000 additional shares of cumulative preferred stock, $100 par, and $2 million of first mortgage bonds due 1979. Proceeds are to be used to pay off $2 million of promissory notes and for construction purposes. (Release No. 9480).

American Gas & Electric Co, New York, has been authorized to make cash advances from time to time to its subsidiary, Appalachian Electric Power Co, Roanoke, Va., so long as the total amount does not exceed $15 million. Appalachian will use the initial advances to pay off bank loans aggregating $8 million and the others for construction purposes, obviating the need for further bank loans under an $18-million line of credit previously established by Appalachian. No interest will be paid on the advances, which will be discharged by an AG&E investment in additional Appalachian common stock (Release No. 9490).

Texas Utilities Co, Dallas, has received authorization to make loans from time to time to its subsidiaries, Texas Electric Service Co, Fort Worth, and Texas Power & Light Co, Dallas, to aid in their construction programs. The loans would not exceed $8 million to Texas Electric and $7 million to Texas Power. Texas Utilities will have available for such purpose approximately $4 million in treasury funds and will borrow from banks no more than $11 million. The loans to the subsidiaries would be repaid when their long-term public financing is completed, in May and June, 1950. Texas Utilities' borrowing will be repaid from proceeds from sale of shares of its common stock, expected before Sept 30, 1950, and from treasury funds (Release No. 9486).

Buffalo Niagara Electric Corp has received authorization to make additional bank borrowings of $5 million to finance its construction program. The borrowings will be made from 12 banks and will be represented by 2½% notes maturing on or before Dec 31, 1950. The company now has outstanding $17 million of unsecured promissory notes due to banks on or before that date (Release No. 9505).

Central Vermont Public Service Corp, Rutland, has received authorization to issue or renew from time to time, until June 30, 1950, or until the company shall have received at least $200,000 from permanent financing, up to a maximum amount (together with all other outstanding short-term notes) of $1,050,000 short-term notes. The company now has outstanding $850,000 of notes issued for construction purposes. Its additional permanent financing is expected to be completed by spring of 1950 (Release No. 9491).

Derby Gas & Electric Corp, New York, has received permission to issue and sell 14,723 shares of its no-par common stock to Allen & Co, New York underwriters, for $284,301.13 ($19.31 a share). Allen & Co will make a public offering of the stock at an initial price not to exceed $20.375 a share (Release No. 9497).

Narragansett Electric Co, Providence, R. I., has been authorized to issue and sell to its parent, New England Electric System, Boston, an additional 60,000 shares of its $50-par stock for $3 million. Proceeds would be used to reduce Narragansett's outstanding short-term note indebtedness (Release No. 9498).

Electric Bond & Share Co, New York, has received authorization to offer 656,295 shares of its holdings of common stock of Middle South Utilities, Inc, New York, for subscription at $12 a share by Bond & Share stockholders of record Nov 9. Bond & Share owns 803,229.63 shares (16.19%) of Middle South stock, of which it must dispose by July 6. The current offering is at the rate of one share of Middle South stock for each eight shares of Bond & Share stock held on the record date. If the rights offering is 100% successful, Bond & Share will need an additional 3,076 shares, which it proposes to acquire in the open market. It also will make stabilization purchases of Middle South stock if necessary. Proceeds will be used to retire, in part, outstanding Bond & Share bank loans aggregating $12 million. Bond & Share also proposes to dispose of 150,010 shares of the Middle South stock by payment of a dividend of 1/35 share of such stock on each share of Bond & Share stock, payable Dec 30, 1949, to holders of record Nov 30 (Release No. 9500).

Thanksgiving Holiday Pulls Output Downward

Electric energy output for the week ended Nov 26 declined slightly from the week before because of the Thanksgiving holiday but increased its lead over the corresponding period of 1948.

The nation's electric light and power companies distributed 5,537,122,000 kwhr during the week ended Nov 26, compared to 5,644,435,000 kwhr the previous week. But last week's output was 3.5% above the 5,349,167,000 kwhr distributed for the week ended Nov 27, 1948.

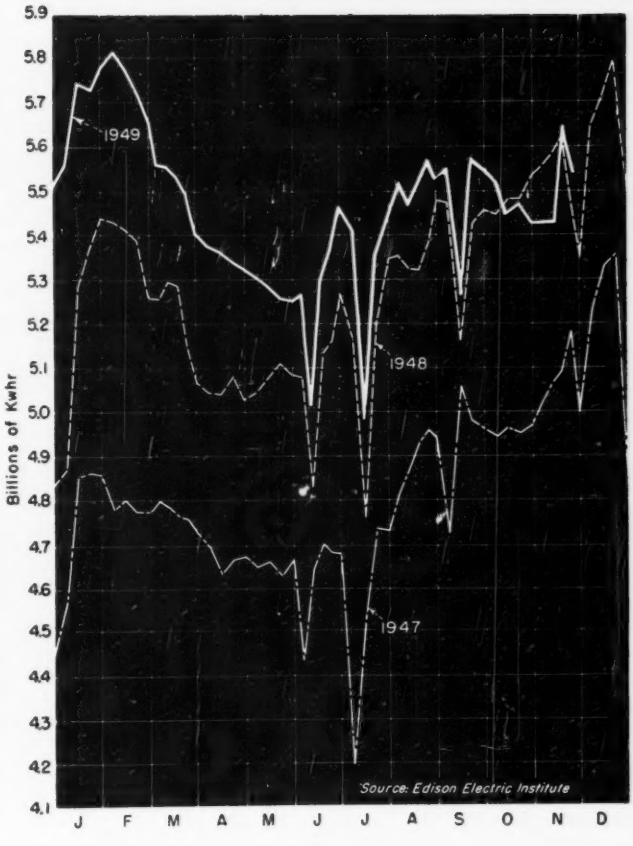
Energy production in every region of the United States showed a gain over last year. The smallest rise, 0.5%, was reported by the Central Industrial states, still recovering from the effects of the coal and steel strikes. Greatest rise, 8.1%, was in the South Central area.

Weekly Output, Millions Kwhr

1949	1948	1947
Nov 26 5,537	Nov 27 5,349	Nov 29 4,983
Nov 19 5,644	Nov 20 5,627	Nov 22 5,180
Nov 12 5,435	Nov 13 5,571	Nov 15 5,084
Nov 5 5,435	Nov 6 5,564	Nov 8 5,057
Oct 29 5,433	Oct 30 5,555	Nov 1 5,009
Oct 22 5,430	Oct 23 5,539	Oct 25 4,964
Oct 15 5,481	Oct 16 5,482	Oct 18 4,946
Oct 8 5,450	Oct 9 5,482	Oct 11 4,958
Oct 1 5,521	Oct 2 5,449	Oct 4 4,935
Sept 24 5,556	Sept 25 5,461	Sept 27 4,956
Sept 17 5,579	Sept 18 5,426	Sept 20 4,977
Sept 10 5,258	Sept 11 5,166	Sept 13 5,053

Percent Change from Previous Year

	Nov. 26	Nov 19	Nov 12
New England	+ 7.4	+ 5.5	+ 3.7
Mid-Atlantic	+ 1.6	— 0.6	— 2.2
Central Industrial	+ 0.5	— 2.7	— 9.7
West Central	+ 6.1	+ 5.0	+ 0.9
Southeast	+ 5.7	+ 2.6	— 2.1
South Central	+ 8.1	+ 5.9	+ 7.4
Rocky Mountain	+ 2.1	— 3.7	+ 0.1
Pacific Coast	+ 5.4	— 0.2	+ 2.0
Total United States	+ 3.5	+ 0.3	— 2.4



Utility Joins Suit to Test Washington PUD Law

Puget Sound Power & Light Co has intervened in the suit filed by Olympia (Wash.) business men to test the constitutionality of a state law which authorizes PUD's jointly to acquire electric utility properties. The case is to be heard at Olympia, Dec 13, by Judge John M. Wilson of Thurston County Superior Court. Thurston County Public Utility District is the defendant.

Constitutionality of the law is challenged on three grounds: 1. It covers more than one subject. 2. It amends a 1931 law without setting forth that law at length. 3. The section of the 1949 law applying to PUD's was added to the original bill and changed its object.

The law was passed by the 1949 state legislature to enable PUD's to purchase the Puget Sound Power & Light Co.

MEETINGS

American Society of Refrigerating Engineers
Annual Meeting, Edgewater Beach Hotel, Chicago, Ill., December 4-7.

Interstate Power Club of New York
December Meeting, Hotel Martinique, New York, N. Y., December 12.

American Society of Agricultural Engineers
Winter Meeting, Stevens Hotel, Chicago, Ill. December 19-21.

National Farm Electrification Conference
Stevens Hotel, Chicago, Ill., December 20-22.

Canadian Electrical Association
Annual Winter Conference, Chateau Frontenac, Quebec, January 16-18.

Plant Maintenance Show and Conference
Auditorium, Cleveland, Ohio, January 16-19.

Southwest Air Conditioning Exposition
Hall of Agriculture and the Poultry Building, Fair Park, Dallas, Tex., January 23-27.

American Society of Heating and Ventilating Engineers
Annual Meeting, Adolphus and Baker Hotels, Dallas, Tex., January 23-27.

American Institute of Electrical Engineers
Winter General Meeting, Hotel Statler, New York, N. Y., January 30-February 3.

Edison Electric Institute
Electrical Equipment Committee, Netherlands-Plaza Hotel, Cincinnati, Ohio, February 13-14; Industrial Relations Committee, Palmer House, Chicago, Ill., February 16; Transmission and Distribution Committee, Statler Hotel, Detroit, Mich., February 20-21.

Pennsylvania Electric Association
Transmission and Distribution Committee, Penn-Harris Hotel, Harrisburg, Pa., February 16-17.

American Society for Testing Materials
Committee Week and Spring Meeting, Hotel William Penn, Pittsburgh, Pa., February 27-March 3.

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Canadians Get Pay Boost

British Columbia Electric Railway Co has boosted wages in Victoria and Vancouver by 5½¢ retroactive to July 29. Wages will be on a monthly instead of hourly scale. Men will work 20 Saturdays or Sundays in a year at straight time to perform work that cannot be done during the week.

WASHINGTON COMMENT

WILLIAM B. WHICHARD

NEW FEDERAL POWER Commissioner Mon C. Wallgren is getting his first taste of the ire of federal power enthusiasts. According to some of the latter, the Commission's freshman member already has set back the cause of civilization and the American way of life by at least half a century.

Wallgren brought this attack on himself. He did so by joining the other four Commissioners in awarding federal licenses for Kings River, Calif., hydro projects to the Pacific Gas & Electric Co and the Fresno Irrigation District. This offended the federal power crowd because the Reclamation Bureau proposed to construct the same projects.

Hardly had the ink dried on the Kings River decision before the self-styled "liberal" columnists began to tee off on Wallgren. Most started with the factual point that the new Commissioner might have refused to participate in the ruling since he had not been on FPC during most of the preliminary proceedings. But non-participation obviously was the least these federal power sympathizers had expected of him. Wallgren, they indicated, should have fought to the last ditch to reverse the decision.

The eminent unfairness of such contentions reached a new high—or low—in the conclusions derived by the most frenzied of the columnists. Among their more snide insinuations were hints that Wallgren had "sold out" or, at best, was bamboozled by private power sources.

It makes little difference that, as both public and private power people know, neither Wallgren nor any other single Commissioner can dictate unanimous FPC decisions. Nor does it matter that FPC gave the Fresno district, a municipal body, the juiciest share of Kings River development in the form of a license to erect the Pine Flat power plant. What really is of importance is that the general public, the majority of readers of the anti-Wallgren columns, is not informed on such matters. They know only "what they read in the papers." And, of course, none of the columnists will bother with the logic of the FPC decision.

Since Commissioner Wallgren has offended once, he may be interested in avoiding a repeat performance. The ground rules, as informally observed by federal power expansionists, are simple. The prime rule is never to block, impede, or even criticize federal plans for power activities.

As Commissioner Wallgren already must be beginning to suspect, retribution is swift for violation of this cardinal rule. By mysterious means, a select group of Washington columnists promptly learns of the offense. The mystery in this is that these pundits rarely, if ever, attend hearings or other proceedings involving major power cases. In fact, most will admit they don't know a kilowatt from a barn door—they just know that federal kilowatts are bigger and better.

From that base any power story is completely simplified. Obviously, anyone who opposes those beautiful federal kilowatts is a stooge of the private utility interests. Or, in first offenses, one who has been misguided by the "interests." This logic does not allow for honest differences of opinion as to the public interest in individual cases.

Fact of the matter is, of course, that the federal power boosters care little whether or not a public official is a "stooge," so long as he is their "stooge." At this point, Mon Wallgren looks like nobody's—least of all the power industry's—"stooge." And that upsets the nice, pat logic of the federal power gang.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Influence factors for laboratory standard instruments need to embrace the effect of heating under continuous energization—the assumption that they are used momentarily or briefly is not too valid.

Flood runoff is being forecast by an electronic setup which integrates the graph of inflow as it affects the lower reaches of the river.

Wood-rot fungi have now been cultivated in pure lignin and the resulting lignin oxidase should throw more light on the prevention of wood decay.

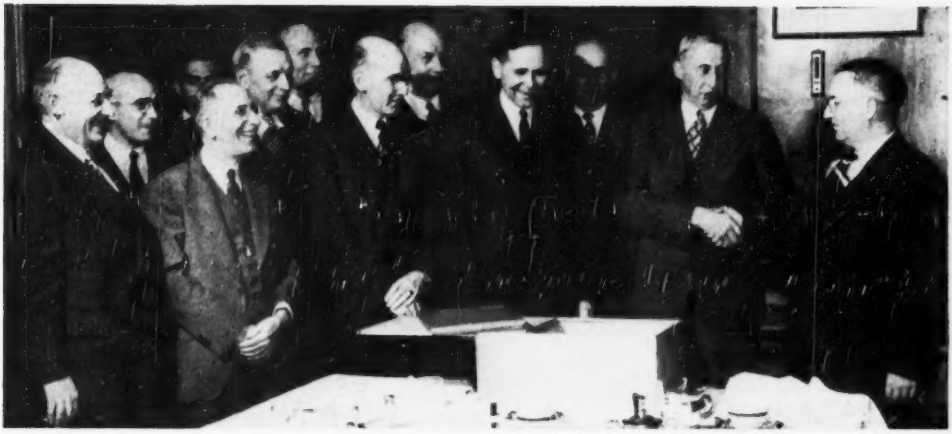
Cables are being made in 2,500 or more different fabrications for all votages and it has been stated that the average order is hardly more than ¼-mile. Individualism can be expensive where such conditions prevail.

Reinforced-concrete water pipe is vulnerable to lightning especially if the reinforcement is discontinuous; a parallel lightning conductor of copper is effective protection.

Smokestacks can emit sound as well as ash or smoke if the boiler draft fans act like sirens at high blade-tip speeds. The temporary remedy has occasionally been a high temperature acoustic baffle well up toward the top of the stack.

Oil circuit breakers command more confidence if they are tripped and the contacts inspected once a month but some utilities deem that pretty often.

Ripple voltage inherently supplied by metal rectifiers can be accentuated to constitute the pulsating supply to tuned vibrating screens and shakers.



MEMBERS of the EEI-NEMA Joint Committee on Standards for Distribution Transformers help E. V. Sayles (Consumers Power) felicitate A. E. Silver (Ebasco) on his retirement. The others, left to right, are the author H. M. Jalonack (General Electric), H. E. Kent and W. T. Smith (EEI), H. A. Enos (American Gas & Elec Serv Corp), M. F. Mitschrich (Moloney), R. D. Rung (Westinghouse), T. D. Brosnan (Buffalo), H. B. Keath (Wagner), H. S. Bennion (EEI), J. B. Hodtum (Allis-Chalmers)

Constructive Standardization Typified by Transformer Program—I

Economic savings attainable without sacrifice of technical progress. Drafting minimized, fabrication and shipment facilitated. Order evolved out of distribution transformer chaos

H. M. JALONACK
Chairman ASA C-57 Subcommittee on Standards for Distribution and Power Transformers

THE MOST important of the gains from transformer standardization are: Lower cost of such transformers compared to the cost without standardization and, therefore, lower prices to the purchaser; savings in inventory charges, both to manufacturer and purchaser; higher quality of product and greater consistency in the quality of the transformer and its performance in operation; shorter or stock shipment; and in a good many cases, reduced installation and maintenance costs.

These gains cannot all be realized without some compromises. The ideas of individual engineers among purchasers are often quite definite as to one or more details of design or construction and it is often necessary for these engineers to make compromises when most of the users do not support these particular ideas. Individual transformer designers in the manufacturers' group should also be willing to compromise when design and construction features which they prefer are not generally acceptable to the users. Such compromises are neither desirable nor necessary if the reliability of the transformers, or their successful operation in service is jeopardized thereby.

Some users fear that the development of improved transformers may be restricted by standardization. This fear is entirely unjustified when standardization proceeds along intelligent lines. This procedure requires avoidance of standardization on such electrical characteristics as losses and exciting current; also on the details of core and coil construction or, in general, on the internal design of the units. Actually, major design improvements are accelerated by eliminating the burdensome engineering and drafting caused by continuous variation in the location of accessories, bushings, mounting lugs, etc. Furthermore, standardization is not a static procedure and standards must be reviewed periodically in the light of operating and manufacturing experience. Under a practical standardization system, changes in external arrangements are assured of careful consideration. This is because an orderly method is provided for the review of existing standards and of recommended changes, thus avoiding the conditions brought about by a

Mr. Jalonack is Manager, Sales Planning Transformer and Allied Product Division, General Electric Co

myriad of individual specifications and by sporadic variations in the requirements.

Common sense in any field of standarization requires that the standards established be generally acceptable to the great majority of users so that they may receive the benefits of standardization. Those who are not in a position to use the standards must still be able to obtain equipment for their needs but it seems obvious that they can not expect to obtain the same benefits that accrue to those who can use the standards.

What is Good Standardization?

It is practical and beneficial to standardize such distribution transformer details as voltage ratings for the high and low voltage sides; the desirability or the non-desirability of taps in certain ratings; where the taps are desirable—the number, range and location of such taps; the type of accessories normally required; the location of these accessories; the bushing arrangement and location; the type of terminals; the method of clamping conductors; the range of opening of such clamps; the type and location of grounding arrangements; the type of mounting lugs and their spacing; kva ratings; required nameplate data; location of nameplate and many other construction details. While opinions in the formative stage of standards may and do differ as to the best selection, an over-all solution can be made in the interests of economical application and economical manufacture. If this solution is wisely arrived at, the resulting standard should be usable by most if not all of the operators.

Accomplishments of Joint Committee

Standards of the kind described have already been developed for single and three-phase distribution transformers, 500 kva and smaller, with high-voltage ratings of 15,000 v and below, and low-voltage ratings of 600 v and below by the EEI-NEMA Joint Committee on Standards for Distribution Transformers. This committee, which consists of equal representation from EEI representing the principal users and from NEMA representing the principal producers, has developed these recommendations—a group of ratings at a time

FIG 1—POLE AND CROSSARM VIBRATION measured for 25-kva transformer

FIG 3—IMPACT TESTING of 35-ft class-4 transformer pole is performed with this experimental set-up in which a 5,400 lb weight is used for swings up to 33-ft arcs

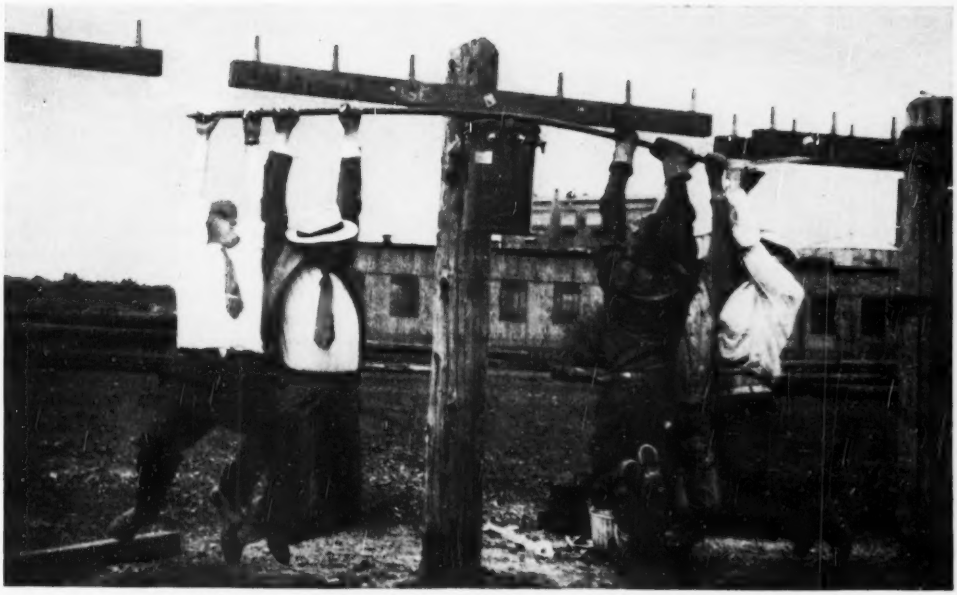


FIG 2—RELATIVE STRENGTHS of various transformer hanging constructions being determined with the assistance of five sturdy men

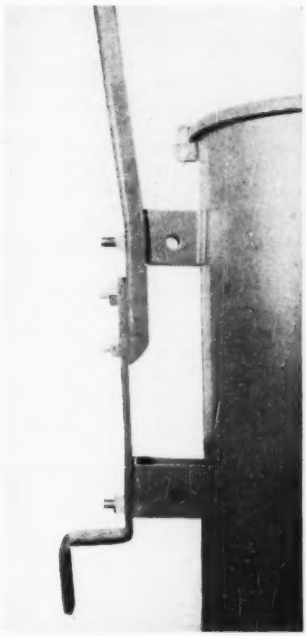


FIG 4—BENT hanger channel and slightly bent bottom bracket due to 3,000-lb arm load

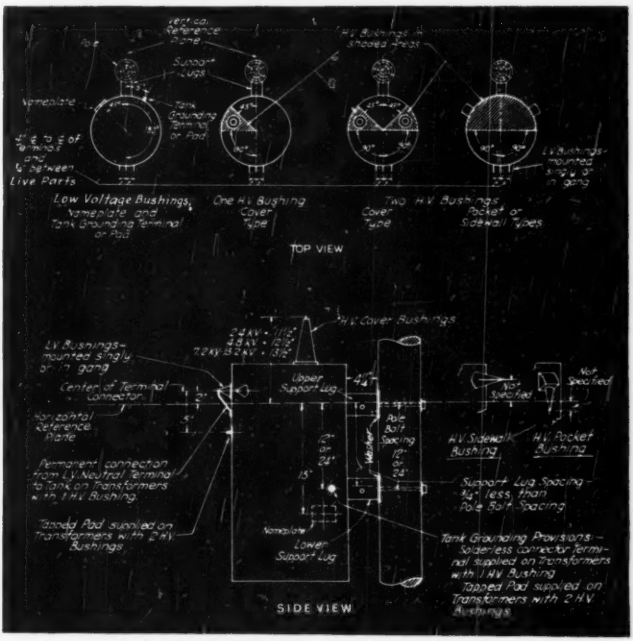

Vertical Reference Plane
Pole
Support Lugs
Nameplate
Tank Grounding Terminal or Pad
H.V. Bushings in Shaded Areas
Low Voltage Bushings, Nameplate and Tank Grounding Terminal or Pad
One H.V. Bushing Cover Type
Two H.V. Bushings Pocket or Sidewall Types
TOP VIEW
H.V. Cover Bushings
L.V. Bushings—mounted singly or in gang
Center of Terminal Connector
Horizontal Reference Plane
Upper Support Lug
Pole Bolt Spacing
Washer
Lower Support Lug
H.V. Sidewall Bushing
H.V. Pocket Bushing
Support Lug Spacing 4" less than Pole Bolt Spacing
Permanent connection from L.V. Neutral Terminal to Tank on Transformers with 1 H.V. Bushing
Tapped Pad supplied on Transformers with 2 H.V. Bushings
Tank Grounding Provisions:—Solderless connector Terminal supplied on Transformers with 1 H.V. Bushing Tapped Pad supplied on Transformers with 2 H.V. Bushings
SIDE VIEW

FIG 5—TYPICAL ILLUSTRATION from EEI-NEMA Standardization reports. Top and side views show locations with respect to vertical and horizontal reference planes

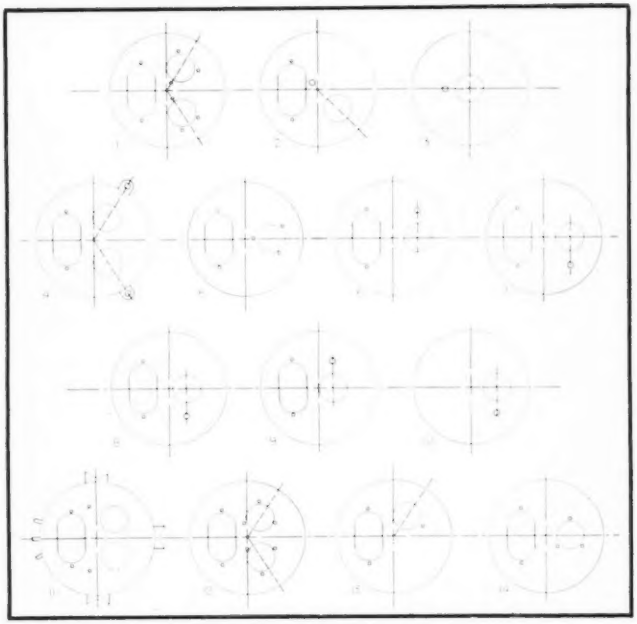


Fig 6—SOME of many cover designs which prompted the standard shown in Fig 5

—over a period of 10 years. During that time the committee met 35 times and it was a rarity indeed to find an absentee at any meeting. Between meetings regular correspondence, questionnaires to advisers and other sources of information were utilized fully to insure consideration of all possible viewpoints. Numerous tests were conducted by users and manufacturers under the general supervision of the committee. Some of these tests are illustrated in the accompanying Figs 1-5.

The findings of this committee appeared in successive publications designated as: "First Report", "First Report Supplement", "Second Report", "Second Report Revised", "Third Report", and "Fourth Report". These reports were reviewed and endorsed prior to publication both by Edison Electric Institute members and by the NEMA Transformer manufacturers through their respective committees and formal approval channels. A typical detailing drawing from these reports is shown in Fig 6.

Before the EEI-NEMA Joint Committee undertook the work of standardizing distribution transformers, the manufacture of such units, particularly pole-type ratings, was in a chaotic condition. A check made by one manufacturer at that time showed 26 different types of transformers, all rated 3 kva, 60 cycle, 7,200 v. The inefficiency of manufacture of so many varieties can readily be imagined without the benefit of much manufacturing experience. Figure 7 shows some of the cover arrangements in general demand at that time; there was similar lack of agreement in the mounting arrangements in regular use. The possible number of combinations and permutations of these separate features explained all too well the large number of separate types that had to be built for each transformer rating.

Reports Relieve Situation

The adoption of the First Report on Standards brought a tremendous relief to this situation, a relief that increased steadily as additional Reports brought further elimination of alternate and optional constructions.

The EEI–NEMA Joint Committee on Standards for Distribution Transformers is now studying the remaining ratings of overhead distribution transformers and also conventional types of subway transformers. A later phase of the work will cover network transformers.

Power Transformer Standardization

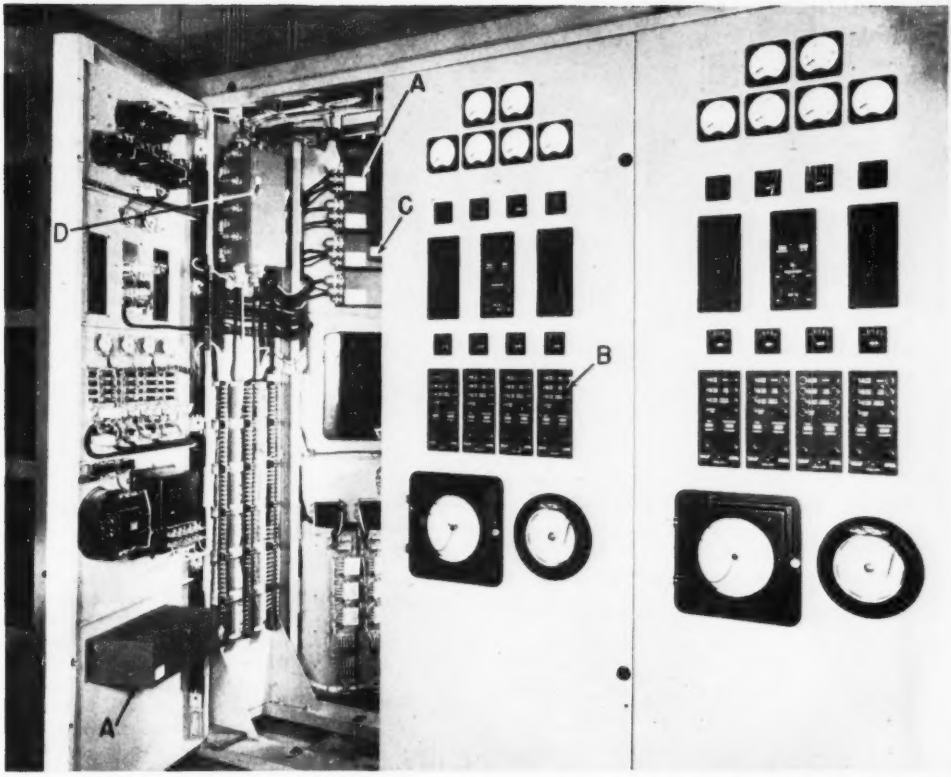
Another important field now under investigation is that of power transformers, particularly those ratings in the small and intermediate ratings which are most apt to be purchased on a repetitive basis. This work is being carried on by a subcommittee of the American Standards Association C-57 Subcommittee.

Fortunately the power transformer situation does not start off as complicated as the distribution transformer situation did before the Joint Committee Reports. Considerable work has already been done on power transformer standardization individually by manufacturers and in the Transformer Section of NEMA. However until the standards on power transformers have been developed by joint action of the users and manufacturers, there will not result the maximum benefits offered by standardization. Incidentally a very important guide to the voltage ratings of both power and distribution transformers has been created by the EEI–NEMA Joint Committee on Preferred Voltages for A-C Systems and Equipment.

Among the important items being studied for standardization on power transformers by the ASA C-57 Subcommittee are:

- Preferred Methods of Oil Preservation
- Preferred Kva and Voltage Ratings
- Preferred Accessories and Accessory Location
- Standard Tests
- Bushing Termination
- Possibility of Interchangeable Bushings
- Arrangement and Location of Bushings and Bushing Clearances

A complete list of Advisers has been established from which will be obtained the guidance of private and public electric operating companies, consulting engineers, industrial companies and other users of this type of equipment.



HALF THE SPACE normally required is ample for this substation control board developed by the Idaho Power Co. Each panel provides control, protective relaying, metering, and instrumentation for power transformer, 12.5 kv bus and up to six feeders. Basic components are control units (A), panel escutcheons (B), common function unit (C), and central distribution unit (D)

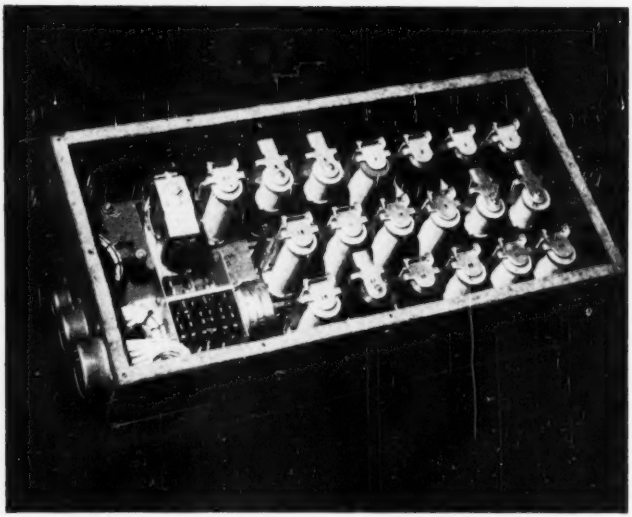
Unitized Control Cuts Space 50% Breaker Operation 35%

LEONARD G. WALKER
Electrical Engineer, Idaho Power Co, Boise

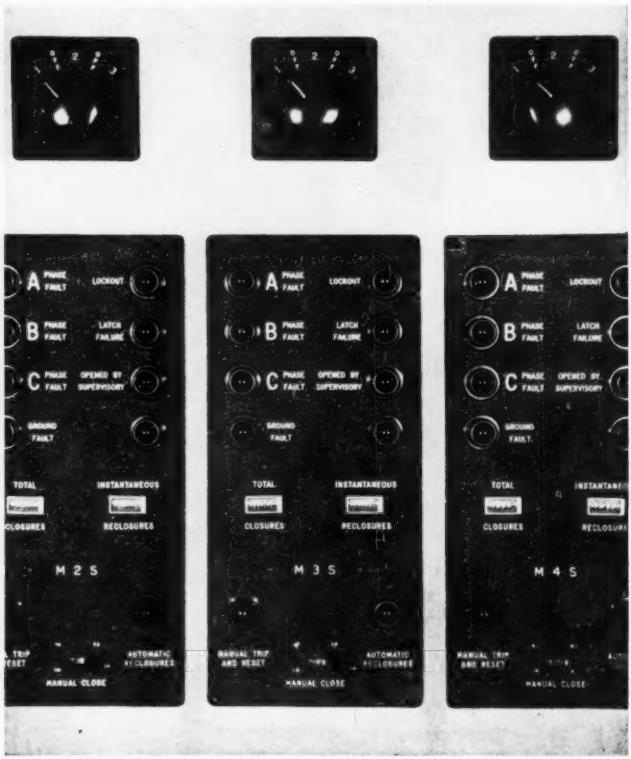
New approach to substation switchboard design employs standardized control components using telephone type equipment to provide great flexibility

REDUCTION of feeder breaker operation by 35%, switchboards requiring less than half the conventional space, and automatically varying breaker reclosing sequence permitting full utilization of coordinated fusing have resulted from a new control system developed by Idaho Power Co. System growth and engineering advances such as coordinated fusing, which Idaho Power Co has used for many years, were demanding more and improved automatic features to eliminate unsatisfactory operating conditions. The new control system solves these problems as well as the additional ones of applying supervisory control, improving operation, reducing maintenance and obtaining control standardization.

The system, called Unit-Trol (a contraction of "unitized control"), takes an entirely different approach



BASIC CONTROL UNIT uses a micro-switch synchronous timer and 20 telephone-type relays. Airplane-type connectors (bottom left) facilitate quick replacement of the unit



COMPACT PANEL ESCUTCHEON has six feeders per panel. Three switches at top are part of 1-amp instrumentation circuits used throughout the control

to switchboard design and construction. Telephone type components are used throughout. The development would have been impossible without the flexibility provided by these components which have proven their reliability by many years of satisfactory service and use by the telephone industry. The basic building block pattern of substation design is followed, treating power transformer, 12.5-kv bus, and associated feeders as a functional unit. Complete control, protective relaying, metering, and instrumentation for such a unit is housed in one small cubicle. The Unit-Trol system consists of: (1) A control unit and panel escutcheon for each feeder: (2) a common function unit; and (3) a central distribution unit for each group of feeders supplied from a common bus. These units are interconnected with multiconductor cable and aircraft type AN connectors.

Control Unit

A control unit which contains one microswitch synchronous timer and a small group of telephone type relays performs all feeder control functions. The scheme, although specially designed for the complex features demanded by modern distribution switching, works equally well on transmission breakers and even on motor-operated disconnects. For maintenance or in case of trouble the whole control unit can be replaced in less than 10 min by removing four bolts and unscrewing the aircraft type connectors.

Electrically isolated tripping and closing contacts for the circuit breaker are supplied by this control unit. The isolation is also carried to the circuit breaker auxiliary switch circuits. Electrical isolation of breaker and control permits the use of a switchyard power bus without any possibility of feedback complications. Since no operating power is carried by the control cable, No. 18 conductor is used instead of the conventional No. 9, saving over 50% in cable cost. Unit-Trol, by reason of its electrical isolation and its inherent anti-pumping design, is not handicapped by breaker internal control scheme nor operating voltage requirements.

A single set of bus section total induction relays performs all backup

functions, therefore each feeder requires only instantaneous relaying. This reduces cost and simplifies protective relaying equipment needed.

The control also provides transient suppression, which by actual field test, results in over 35% reduction of feeder breaker operation. This suppression is accomplished by inserting a 13 cycle delay between the operation of the reclosing control changes automatically to cope with almost unlimited fault conditions, and is particularly adapted to coordinated fuse protected feeders. The basic reclosing cycle for permanent faults provides two tests, one at zero time and another at 15 sec, before an attempt is made to blow a sectionalizing fuse at 50 sec. This cycle varies automatically from three instantaneous reclosures for lightning faults occurring within the reclosing period, through a number of variations to the combination of a momentary fault followed by a permanent fault occurring after the fuse blowing period, which produces a recycling to blow a sectionalizing fuse in this second cycle.

Control Escutcheon

The control escutcheon mounts a single three-position control key, indicating lights, and two counters. All control functions for each feeder are selected by the one control key (see photograph). This eliminates any possibility of mis-operation through failure to coordinate properly two or more manual switches, since only one switch is involved. The pilot lamp presentation on each escutcheon shows not only breaker position, but also fault type (phase A, B, C, or ground), lockout, failures of the circuit breaker latch, and supervisory operation. This makes all pertinent information available to the operator at one point. The fault-indicating lamps reset automatically at the end of each successful reclosing sequence. Indication of the fault actually causing lockout is therefore the only one retained. Total breaker operations and instantaneous reclosing operations are recorded separately on two counters. A comparison of change in the two readings over a period of time shows whether the breaker has reclosed instantaneously on all faults or whether there have been multiple reclosures with a consequent outage of 15 sec or more.

Common Function Unit

Each common function unit serves one entire bus section. It provides transfer of lamp circuits to the emergency power source, supervision of control power, transfer of backup protection, and coordination with other bus sections during sectionalizing or paralleling of circuits.

The central distribution unit (also one per bus section) serves as a junction box and provides all interconnection needed between unit components and terminal blocks.

Unit-Trol is well-adapted to supervisory installations since the telephone contacts in the supervisory equipment can be wired directly to the telephone relay operating coils in the control case. This eliminates the heavy duty interposing relays otherwise required. Preferential interlocks are provided as a basic part of the circuit so that when the breaker is opened by either manual or supervisory control it cannot be closed until the function initiating the opening releases its clearance.

Additional automatic features are easily added with this type of circuit design. For example, automatic sectionalizing of an entire five bus section station, in case of differential operation, restores all remaining operative equipment within four seconds.

Other Savings

A saving of approximately 50% in switchboard space with no increase in switchboard cost reflects a substantial saving in the size and cost of control buildings. This space saving is realized even though the switchboard includes local service load centers, battery chargers, and supervisory control equipment normally mounted separately.

Following conception of the Unit-Trol idea in the spring of 1945 development and design was carried on and the first prototype of the apparatus in use today was completed in August 1945. Extensive laboratory and field tests were conducted with construction of the present equipment starting in 1948. The first major installation of Unit-Trol on the Idaho Power Co system was made January 1949 at the company's Nampa substation, near Boise.

This completely modern, 22,500-kva, 69/12.5-kv, supervisory controlled station with all its advanced features was constructed at a lower dollar per kilowatt cost than stations of comparable size built by the company in 1923 and 1929. At Nampa control is provided for 17 distribution breakers, 3 transmission breakers, and 5 air break switches.

Including this installation, control for 81 distribution breakers, 10 transmission breakers, and 18 transmission air break switches has been constructed and installed at other stations in 1949 or is scheduled for 1950, using Unit-Trol.

Maintenance Eased and Benefits Extended

SEVERAL MEASURES taken recently by Toledo Edison Co have proven effective in reducing cost and facilitating maintenance operations.

An air drill and reduction-gear device is used to rotate large machinery in place, allowing machine work on shafts, sleeves, and bearings to be done on the job. This saves the time spent dismantling equipment and taking parts to the shop.

In a new method for painting steel fence, two men using push brooms can cover 300 to 400 ft of fence in a day. Excess paint is caught in troughs placed under the fence. This method has been found to be several times faster than the usual paintbrush method.

A new grease gun with accessories was installed for car and truck maintenance. The gun has a pressure of 6,000 psi and was engineered to use a heavy barium grease. This grease extends lubrication periods to 2,000 miles instead of the usual 1,000-mile service.

DEMONSTRATIONS are the best sales tool for commercial cooking. Here an AEPCo salesman puts a waffle baker through its paces

HEAVY sales emphasis is put on the fry kettle as an excellent profit maker for the customer and a revenue producer for the utility

Organized Selling Gets Results

R. S. MUSGRAVE
Division Commercial Manager
Appalachian Electric Power Co
Huntington, West Virginia

MORE AND BETTER RESULTS come from organized than from random sales efforts. That's a truism to which every power company sales manager subscribes, but which more than a few forget in the actual conduct of their work. We in the Huntington division of the Appalachian Electric Power Co who handle commercial and industrial sales were among those who paid hardly more than lip service to the value of organized sales effort. Then we decided to practice our religion and we have discovered that it pays.

We set up a detailed schedule of promotion and sales activities in one of our three districts for the 12 months of 1949. The schedule is summarized in an accompanying panel. The work it includes is directed towards profitable load building among 5,000 small commercial and industrial customers. The field force consists of five salesmen. Directly resulting from the scheduled activities in the first six months—all increases traceable to other origins excluded—were estimated annual increases of 502,165 kwhr in energy sales and of $11,233.80 in revenue. Statement of the half-year results, so far as they are available, also appears in this panel. Complete statement is not possible because finished installations always lag behind jobs sold.

Comparison of the information in the panel discloses that in this matter of customer calls the program was not lived up to. In the first six months considerably more than the stated number of 655 calls were scheduled. Actually, 594 calls were made. It was found impossible for five men to follow up 100 or more letters a month and also make the "re-calls" necessary for developing sales. Also, in working according to the schedule, a salesman often enough finds himself using his time to make a sale entirely different from what he had in mind when he called.

For instance, one of the five salesmen, making a routine lighting call, discovered that the customer, a small bakery specializing in pies, was unable to supply the demand for the product. A fuel-fired oven was turning out pies at a rate of 1,350 an hour, much too slowly for the growing business. There was no stock electric oven that would fit the particular requirements of the job. Arrangements were made with a manufacturer for a custom-built conveyor-type oven. Now the pies are pouring out, 4,000 of them an hour. The salesman got 'way behind in his scheduled lighting calls that month, but he did the customer, the company, and himself a lot of good.

Experience having proved in the first six months that the bite was rather too big for effective chewing, the schedule has been revised to somewhat more modest proportions for the remaining half year. Experience in this period, with that of the

This article was developed from the author's paper, "Successful Approach to the 'Low-Use' Customer Market," presented at the recent sales section meeting of the Southeastern Electric Exchange.

first half, will provide a base for a more accurate specification of activities for 1950. Also the plan will then be put into operation in the other two districts of the Huntington division of the company.

The small commercial and industrial customer class is, we believe, a fertile field just waiting for load cultivation. The Appalachian Electric Power Co has some 40,000 such customers. On the average, each of them uses 556 kwhr and supplies $14.50 of revenue per month. Groceries, restaurants, drug stores, filling stations, barber shops, beauty parlors, garages, offices, repair shops and small factories—they need and can use profitably every service to which electricity can be turned. Uninformed on the electric services they can use advantageously, too small to afford professional engineering advice, they are a "natural" for load building. In cooperation with electrical contractors, dealers and distributors, the power company can benefit these customers in the small commercial and industrial classes most by organized, rather than random, sales activity.

This Is The Schedule . . .

of Promotional Activities among Small Commercial and Industrial Customers

Commercial Cooking

Make 8 fry kettle demonstrations—Every month

Make 25 general promotion calls—January-May, September-December

Dinner meeting with cooking equipment distributors to enlist them in promotion—January

Aid cooking equipment dealers at wholesale market meeting—January

Demonstrate counter cooking equipment at luncheon—February, restaurant operators; March, drug store operators; April, May, Drive-in stand operators

Send literature on restaurant ventilation to 50 food service customers and follow up with calls on each one—June, July

Make 15 calls on hotels and hospitals—August

Demonstrate portable food warmers at 5 schools—September

Make 10 demonstrations of electric coffee maker in cooperation with coffee suppliers—October

Make 8 waffle baker demonstrations—November

General Promotion of Lighting

Dinner for electrical contractors and dealers to explain program of lighting promotion starting in March-February

Store Lighting

Send literature to 100 prospects and follow up with calls on each—March, April, September, October

School Lighting

Presentation of school lighting display at all meetings in one week of local service clubs, to PTA Council at luncheon meeting, to school boards at dinner meeting and to public in lobby of company office for 3 weeks—February

Industrial Lighting

Send literature to 25 prospects and follow up with calls on each—March, April, September, October

Office Lighting

Send literature or letters or both to 100 commercial-office and to 25 industrial-office prospects and follow up with calls on each one—November, December

Christmas Lighting

Send letter to 100 merchants offering Christmas lighting designs and recommendations—November

Window and Sign Lighting

Send letter to 100 customers and follow up with calls on each—January

Flood Lighting

Make 4 or 5 sales presentations to community sponsors of sports flood lighting—July

Send literature or letters or both to 100 prospective users of commercial flood lighting and follow up with calls on each—July, August

Send literature or letters or both to 25 prospective users of industrial flood lighting and follow up with calls on each—July

Industrial Electric Heat

Send letters to all laundries stating advantages of infrared and other electric heat and follow up with calls on each—January

Send mailing pieces or letter on infrared drying to garages and to automobile dealers and follow up with calls, arranging for showing of portable equipment—February

Send mailing pieces or letters on infrared paint drying to small wood working and metal fabrication shops and follow up with calls on each, arranging for testing of samples or other production engineering assistance—February

Air Conditioning

Send literature or letter or both to 150 prospects and follow up with calls on each—May, June

Dinner for air conditioning equipment dealers—May

Industrial Plant Ventilation

Send literature or letter or both to 25 prospects and follow up with calls on each—June

Materials Handling

Send literature or letter or both to 30 prospects and follow up with calls on each—May

Adequate Wiring

Send literature or letter or both to 25 industrial prospects and follow up with calls on each—August

These Are The Results . . .

of 6 Months of Scheduled Sales Activity With Five Field Salesmen Working among 5,000 Small Commercial and Industrial Customers

Number of calls	594
Number of demonstrations	47
Number of customers interested	302
Number of customers sold	147
Number of prospects for loads other than contemplated in scheduled calls	109
Connected load sold—Kw	417.4
Estimated annual use of energy—Kwhr	502,165
Estimated annual revenue	$11,233.80

O. H. HUTCHINGS STATION completed a year of operation of the initial 60-kw unit on July 5, 1949. The second was put into operation on March 11 having been erected in 27 days. The third and fourth units will use reheat and are scheduled to go on the line in 1950 and 1951

Hutchings Station Design Confirmed by Year's Operation

Thermal efficiency 31.3%. Semi-outdoor boilers satisfactory. Seven men for two units. Gravel pit now takes ash. Condensing recirculation provided. Next pair of units to be reheat

H. E. DEARDORFF
Vice President, Dayton Power & Light Co

LOCATION OF A SITE for the proposed O H Hutchings Station involved careful evaluation of many factors applied to at least eleven potential sites downstream from Frank M Tait Station previously the sole source of generation within the company. A total of 14 factors were set up as imperative criteria. All were carefully investigated and evaluated for each contemplated site because, the topography of the Miami river valley and the industrial concentration in the valley dictated there must be no error of judgment.

Among the factors studied, the condition of the river and availability of ash disposal areas, railroad facilities, transmission line rights of way, and nearness to highways were paramount. The site selected on the basis of these preceding factors was all the more favorable for the reason that it happened to be the largest of all parcels of land under consideration and in addition possessed very suitable foundation conditions and underground water supply.

A fair percentage of the cost of the first two units at Hutchings Station is reflected in the work that had to be done to the river. At the plant site, the original channel of the river was straightened and made deeper and wider. Levees were constructed to contain the river during high water periods. The station proper is constructed on a level which is above a theoretical level that the river would attain if it was carrying flood water 40% in excess of the disastrous maximum flood conditions of 1913.

The temperature of condensing water for Hutchings Station is not affected by the discharge from Tait Station which is 14.5 miles upstream. The intervening distance affords ample cooling by evaporation coupled with the fact that the temperature downstream is conditioned by the discharge from sewers and other small drainage streams.

The condensing equipment for each of the 60,000-kw units now in service requires 43,000 gal of water per min and when four additional units are

installed (No. 3 and No. 4 with reheat) it may be necessary to do some recirculating of water at the station site during periods of low flow in the river. For this purpose an impounding basin has been erected, formed by damming the river 500 yd below the circulating water intake. The dam is 480 ft long.

A 1,300 ft canal conducts the discharge water from the building to the dam where three motor-operated gates, one above and two below the dam, control its disposition. It is normally discharged below the dam, but may be returned to the impounding basin during periods of limited supply. Water may be recirculated from the discharge canal through a 60-in. pipe to the intake channel to provide for ice control during the winter.

Three excellent deep wells have been developed on the station property. These wells supply cooling water at 56 F for coolers and for building sanitation and drinking purposes.

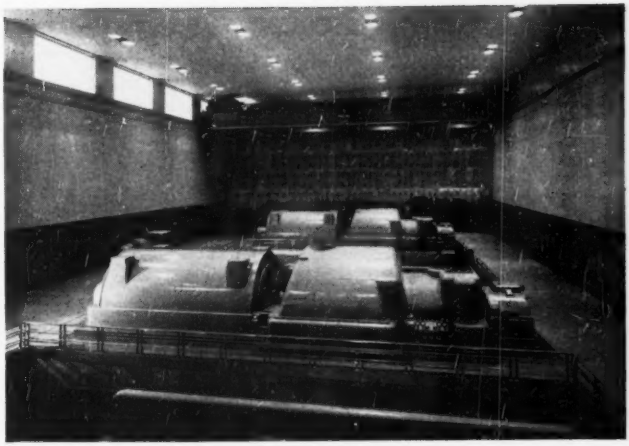
Gravel Pit for Ash

All aggregates used in foundation work and other erection were obtained from gravel pits developed on the site. These pits having yielded the aggregates are now available as spoilage areas and the ash disposal problem will be nonexistent for many years to come.

Since construction work was started on O H Hutchings Station just as soon as was practicable following the cessation of hostilities, the period of rising prices that followed resulted in higher construction costs per installed kw over that which obtained in 1940-41. It followed therefore that the design of the station should be along the lines that would offset comparatively high first costs of station construction through the reduction of operating and maintenance costs.

Every effort has been made to make the station a convenient and attractive place in which to work. The station is completely tiled and is ventilated with forced air. There is one completely air-conditioned electrical control room for the switchboard operator. This room and the operator will serve all units of the station. The mechanical control room is air conditioned and it serves two units.

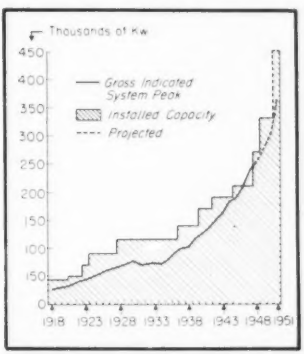
In addition to the switchboard operator, six other men—the shift engineer, control operator, assistant operator, auxiliary operator, apprentice operator and watchman—constitute the operating force. Each additional two units will have another mechanical control room and will require two more operators for each unit.



UNITS No. 1 and No. 2 are 60 Mw each and two more units of the same capacity with reheat are being installed behind the temporary wall. Return of 25.4% is expected on the additional reheat investment due to coal savings effected, based on 55% load factor

The station is integrally connected with a three-story service building which provides office space for management and station control. All offices in the service building area are air conditioned.

The station has been laid out on the unit principle with one boiler and one turbine-generator constituting a unit. Each unit is completely independent of all others to its 69-kv bus breaker. Prior to installation on the site of No. 2 turbine-generator, all work was completed on the boiler and auxiliaries for this unit using temporary connections with No. 1 turbine-generator. Operating experience on No. 2 boiler was gained in advance by this method.

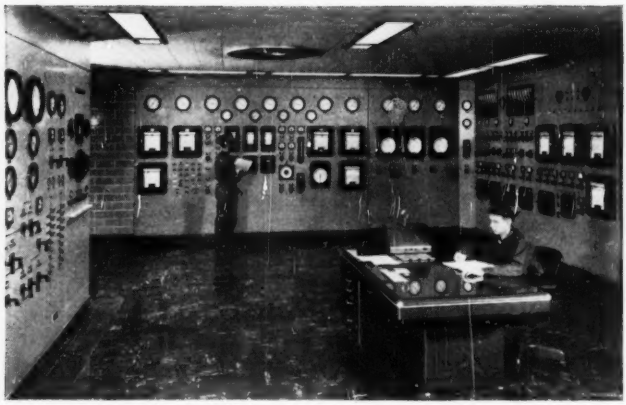


INCREMENTS at Tait Station brought its aggregate to 210 Mw in 1946. The four new units at the Hutchings Station will add 240 Mw to keep ahead of projected peak

The two turbines now in service are General Electric 60,000-kw, 3600-rpm, 21-stage tandem-compound double-flow units designed for 1,250 psi and 950 F and 1.5 in. Hg absolute back pressure.

The generators are General Electric 70,588-kva, 0.85-pf, 3600-rpm, 60-cycle, 12,500-v, 3-phase, self-ventilating machines designed for operation up to 15 psi but operated at 0.5 psi hydrogen pressure. Cooling, in all seasons, is effected by well water. The field is excited by a 200-kw, 250-v, 1200-rpm, shunt wound generator, driven by a 300-hp, 2300-v motor and regulated by a General Electric amplidyne voltage regulator. Although no spare exciter has been provided, in the ultimate plan an exciter bus, serving all units will permit interchange of excitation current between fields.

The steam generators are three-drum, radiant-furnace type manufactured by Combustion Engineering—Superheater Inc, each having a continuous capacity of 500,000 lb of steam per hr at 1,350 psi and 950 F when supplied with feed water at 450 F. The maximum capacity is



CONTROL ROOMS are air-conditioned. One control assembly for each pair of units. Mechanical controls for unit No. 1 are duplicated on opposite wall for companion unit

designated at 550,000 lb per hr for a period of 12 hr.

The bottom of each furnace is of the dry, basket type, formed by inclining the front and rear wall tubes. Water is maintained in the ash hopper to quench the base ash.

Pulverized coal is fired tangentially from three tilting burners in each of four corners of the furnace. Gas fired torches are used for ignition purposes. The boiler may be fired by gas and raised to operating pressure without the use of coal.

The station is one of the first north of the Mason-Dixon line to have gone in service with boilers of the semi-outdoor type. After a year of operation, the favorable heat rate of the station gives further justification to this original decision.

Each boiler is enclosed with insulated panels at the burner and drum levels. Two boilers discharge flue gas into a single stack, 250 ft high.

Isolated-phase Bus

Generated power is transmitted through ITE metallically enclosed isolated-phase buses to 21,667-kva, 69.0—12.5-kv, oil insulated, self cooled Westinghouse single phase transformers. Work is under way to equip these transformers with forced air cooling.

Each transformer is in its own bay adjacent to the station building and is protected by a Mulsifire system. No spare transformer is contemplated for the nine transformers that will be in service for the first three units. Unit No. 4 will be equipped with a Westinghouse, 3-phase, 60-cycle, 60,000-kva, self-cooled transformer and with forced air cooling, it will have a capacity of 75,000 kva.

The two 60,000-kw units now operating under throttle conditions of 1,250 psi and 950 F are performing well within the design expectations. When it was decided to install the next two additional units a study was made to determine whether the use of a reheat cycle would prove advantageous. This study was based on two 60,000 kw reheat units with initial steam conditions of 1,450 psi and 1,000 F with reheat to 1,000 F. The estimated heat rate of this cycle when compared with the performance on record for the first two units showed that the reheat units under consideration would reduce the heat rate 9% or 1,000 Btu per kwhr sendout.

On Units No. 3 and No. 4, the initial cost of the turbines, boilers and necessary piping will be higher than for No. 1 and No. 2 but other economies will be effected by using smaller boiler feed pump motors, induced draft fan motors and other items. When fuel savings are taken into account, it is estimated that at 55% load factor, net savings on the two additional units with reheat will produce a return of 25.4% on the additional investment. Accordingly contracts were let to employ reheat on Unit No. 3 for which construction has already started and for Unit No. 4. Unit No. 3 is expected to go on the line during 1950 and Unit No. 4 is scheduled for 1951 operation.

One Year of O H Hutchings Station Performance Data

(July 6, 1948, through July 5, 1949)

STATION

Total generation, net, kwhr	503,137,000
Heating value of coal, Btu/lb	13,045
Coal rate, net, lb/kwhr	0.836
Heat rate, net, Btu/kwhr	10,904
Steam rate, net, lb/kwhr	8.68
Boiler efficiency, %	88.90
Thermal efficiency, %	31.30

BOILER OPERATION

	No. 1 Boiler		No. 2 Boiler	
	Hours	Percent	Hours	Percent
Period hours	8,742.2	100.00	6,751.1	100.00
Service hours	6,045.0	69.15	3,555.6	52.67
Available but not operated	1,332.4	15.24	1,786.9	26.47
Total availability	(See notes below)			

TURBINE OPERATION

	No. 1 Turbine		No. 2 Turbine	
	Hours	Percent	Hours	Percent
Period hours	8,742.2	100.00	2,790.8	100.00
Service hours	7,856.1	89.86	2,240.1	80.27
Available but not operated	783.6	8.96	527.2	18.89
Total availability	8,639.7	98.82	2,767.3	99.16

STARTING DATES OF MAJOR EQUIPMENT

No. 1 Boiler	5:48 PM, July 6, 1948
No. 2 Boiler	4:55 PM, Sept 27, 1948
No. 1 Turbine	5:48 PM, July 6, 1948
No. 2 Turbine	5:11 PM, Mar 11, 1949

Total availability figures are not indicated for boilers No. 1 and No. 2 since unusual outages were experienced during the early weeks of their operation. These were occasioned by insulating material on the interior surfaces of the ducts and breeching falling off and causing boiler outages. Failure of a local contractor to follow boiler manufacturers' specifications in applying the insulating materials was the cause of the trouble and was corrected by completely reinsulating the affected parts according to specifications. Since the second turbine generator had not yet been installed, both boilers were available through temporary piping arrangements for service with Unit No. 1 and the troubles outlined did not seriously affect the continued operation of this unit.

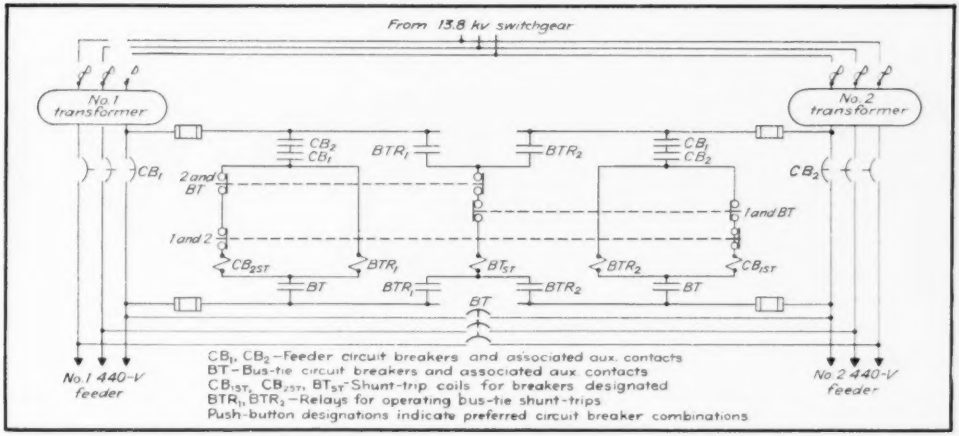


FIG 1—ELECTRICAL INTERLOCKING of feeder and bus tie breakers in a two-transformer station service installation provides for momentary paralleling of the transformer secondaries and automatic tripping of desired breaker by means of shunt-trip devices

Electrical Interlocking Saves on Breaker Costs

Unique scheme offers many advantages over installation having transformer secondaries paralleled. Shunt-trip devices automatically trip desired breaker

FRANK E. REEVES
Power Plant Design Engineer
Barnard & Burk, Consulting Engineers
Baton Rouge, La.

CONSIDERABLE SAVING may be realized by not paralleling the secondaries of station service transformers in that 600-v circuit breakers of lower interrupting capacity may often be used. Another advantage is greater reliability since failure of one transformer will result in shutting down only the auxiliaries which it is feeding. The load on the other transformer or transformers need not be interrupted and the station may operate on reduced load, at least.

Where 440-v bus-ties are used and no other precautions taken, there is the possibility of a dangerous condition existing if the bus ties are left closed when all feeder breakers are closed. Under this condition a heavy short-circuit might result in damage to the circuit breakers involved and cause prolonged outage.

Figure 1 is a scheme for the complete electrical interlocking of the feeder and bus-tie breakers in a two-transformer station service installation. It provides for momentary paralleling of the transformer secondaries and automatic tripping of the desired breaker by means of shunt-trip devices, which are standard accessories. Breakers are manually closed type. A transformer may be taken out and restored to service without outage of the 440-v feeder.

Assume the normal condition with both feeder breakers closed and the bus-tie breaker open. If No. 2 Transformer is to be taken out of service, two-pole push button marked "1 & BT" is actuated and the bus-tie breaker closed. Number 2 feeder breaker (CB_2) will automatically trip as its shunt trip coil (CB_{2ST}) will become energized through normally-open auxiliary contacts of all three breakers. The push button may then be released. Load on 440-v feeder No. 2 will not be interrupted since the bus-tie breaker must close before its auxiliary contact closes to complete the tripping circuit.

To restore transformer No. 1 to service, double-pole push button marked "1 & 2" is actuated and held until No. 2 feeder breaker is closed manually. The bus-tie breaker will automatically trip and again there will be no outage of feeder No 2.

Transformer No. 1 may be taken out and restored in a similar manner since the circuit is electrically symmetrical.

In the actual design, control transformers were incorporated to permit the use of 115-v shunt-trip and relay coils, and a howler was used to give audible indication that the interlocks failed and two or more transformers are in parallel.

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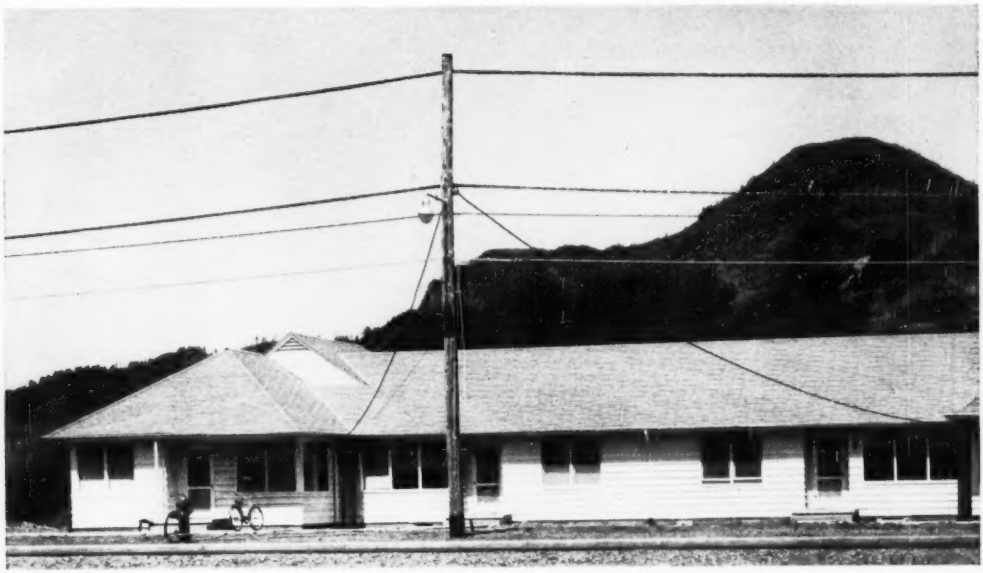


AERIAL CABLE was used exclusively by the U. S. Army Engineers for the complete distribution system—primary, secondary, service drops and street lighting—in this housing project near Bonneville dam. Aerial cable system provides space for telephone facilities with minimum

Distribution System Uses Aerial

Self-supporting cable, inherently simpler to install than open wire, used for primary, secondary, street lighting and service drops

RELIABILITY, safety, appearance and economy of self-supporting aerial cable resulted in its selection by the U. S. Army Engineers for a complete distribution system serving a small group of apartment houses at Bonneville dam. Over 5,000 ft of cable were used in primary and secondary circuits, service drops and street lighting. Cost estimates for underground, aerial cable and open wire distribution systems, based on contract installation, were approximately $20,000, $10,000 and $6,000 respectively. Selection of aerial cable was the best compromise between the more desirable appearance of underground and lower cost of open wire. Other factors considered were voltage regulation, radio interference and additional cost of street lighting and telephone facilities.

Each fourplex structure on the project consists of two two-bedroom and two three-bedroom apartments. All units are electrically heated with individually thermostatically controlled radiant convection-type heaters. Total connected heating loads for individual apartments are 13.25 and 18.75 kw, with maximum individual heater size of 3 kw. Diversified demands, considerably higher due to heating than normally expected in purely residential areas, were estimated to be:

2 bedroom apt	17.7 kw
3 bedroom apt	22 kw
2 bedroom plus 3 bedroom (one service)	30 kw
1 building	51 kw
5 buildings (present number)	218 kw
7 buildings (ultimate number)	300 kw

Conductor sizes were determined by voltage drop criteria based on these load estimates. Service drops, each of which must serve the load of two apartments, are 3/c No. 2; secondary circuits are 3/c No. 4/0; primary circuits are 3/c No. 4/0 (3 kv); and 3/c No. 10 was used for street lighting circuits. Okolite-Okoprene Dualay bound to a Copperweld messenger with copper tape was used throughout, with the messenger taking all mechanical stress and doubling as a neutral conductor. Primary circuit is 2,400-v delta, secondary is three-phase, four-wire 120/208 v,

incremental pole height investment compared to underground telephone circuits

THREE-PHASE transformer tap is facilitated by Dualay construction of cable. Special clamp attaches the Copperweld to the pole without breaking binder tape

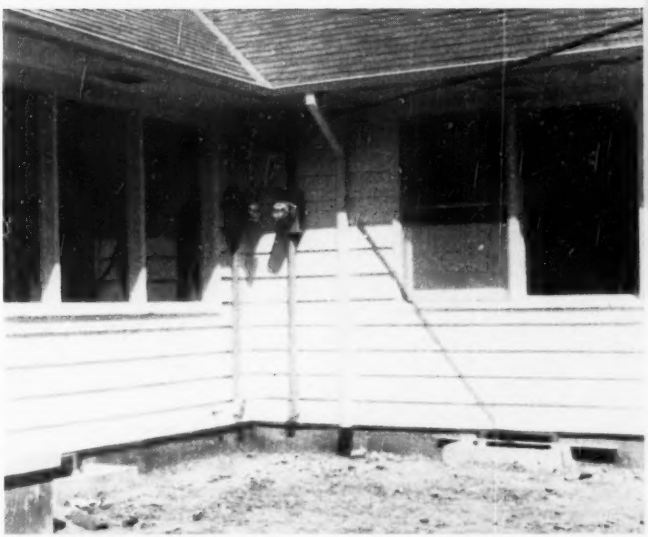
Cable Throughout

W. H. RUSSELL
Electrical Engineer
U. S. Corps of Engineers
Portland, Ore.

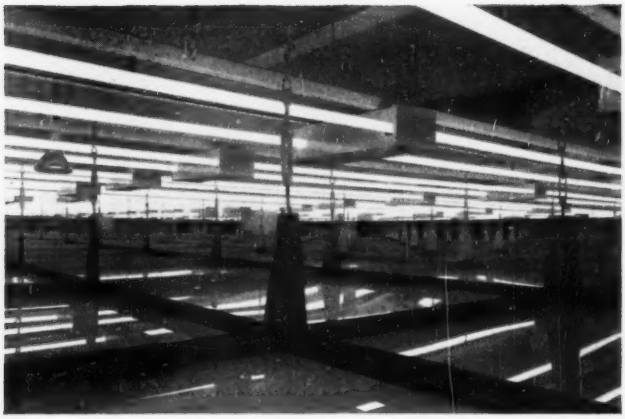
with transformer secondaries banked together. Some overloading of the transformers is anticipated during the heating season, but ambient conditions will provide some additional cooling at the same time.

Underground cable sizes for the system would have been determined by thermal conductivity rather than voltage drop requirements. Were conductivity the only governing factor, an underground system would have required something more than twice the copper of an equivalent aerial cable installation.

One of the important advantages of an overhead system compared to an underground system for the project, was relative cost of street lighting facilities. Both open wire and aerial cable installations provide supporting structures for luminaires and necessary wiring. Additional cost of an underground lighting system with standards, cable duct and trenching would have been about $5,000.



DIVERSIFIED DEMAND of 30 kw required heavy (3/c No. 2) service drop for each two apartments. Electric heating loads have reached 13.25 and 18.75 kw per apartment



COLD-CATHODE LIGHTING above suspension framework for transluscent panels in an approach to shadowless illumination. Emergency lighting fixture at extreme left center

PLEXIGLASS removed from panels to show fluorescent tubing accessible for maintenance

Full Luminous Ceiling for

Barbadoes Station has paneled translucent ceiling illuminated for 25 ft-c by cold-cathode fluorescent above. Variation only 4%

A. A. BRAINERD and W. H. JOHNSON
Philadelphia Electric Co

THE 132,000-kw addition to the Philadelphia Electric Company's Barbadoes Station incorporates a radical departure from conventional control room lighting, in that a completely luminous suspended ceiling has been installed. The use of 3,500 K white, 100-ma, 25-mm, 1,300-lumen, series-connected cold-cathode lamps with white translucent "Plexiglas" panels as a diffusing medium is the principal feature of the installation. The ceiling which extends over the entire control room area, provides a uniform, low brightness light source and produces an "in-service" illumination level of 25 ft-c measured at any point between floor and ceiling. The most striking effect of the installation lies in the initial impression which results on entering the control room, which is one of being unable to attribute the illumination observed to the luminous surface over-head.

The design of a completely satisfactory lighting system for control rooms of generating stations has presented problems which have been difficult of solution. Most prominent among the difficulties encountered have been the production of uniform illumination on both horizontal and vertical working surfaces with a minimum of shadows, absence of reflections on instrument lenses and other bright surfaces, and a minimum brightness consistent with adequate illumination levels.

Early in the preliminary design of lighting equipment for Barbadoes Station, progress in control room lighting was carefully reviewed and it was decided to employ cold cathode lamps similar to those installed at Southwark Station, *since this type of lamp offers the best combination of long lamp life, low brightness, and high efficiency yet developed. In addition to the standard lamp characteristics of 25 mm diameter, 3,500 K white color and series connected previously specified, it was stipulated that the lamps employed in this application must be capable of producing not less than 1,300 lumens after 100 hours burning time. This was to standardize light output and to attain a degree of uniformity heretofore sometimes lacking in this type lamp.

* *Illuminating Engineering*, February 1948.

Infinite Source Approximated

A practical approach to shadowless illumination requires an infinite, uniformly luminous light source. With such a light source, uniform illumination irrespective of distance from the source will result. This effect may be achieved by means of an indirect system, or by lighting from above as in a luminous ceiling. In order to apply this principle in the luminous ceiling design, it was necessary to decide on a type of diffusing material, illumination level required, spacing and number of lamps, type of lamp reflector, distance between lamps and diffusing material, and the effect of obstructions in the cavity above the luminous surface.

White, translucent "Plexiglas" was

CONTROL ROOM of Barbadoes station has luminous ceiling of suspended translucent material to achieve the effect of uniform illumination irrespective of distance from the source

Control Room Lighting

selected as the diffusing medium, after a consideration of available technical data concerning its light transmission, color and flammability. Sheets of "Plexiglas" 3-ft sq and ¼-in thick were selected as representing the largest panel which could be horizontally supported without excessive center deflection and consistent with a minimum weight. These were supported in a framework constructed of 1¾ by 1¾ in. aluminum lacquered tee members suspended from the roof of the cavity.

Mock-up Made First

A nine panel "mock-up" was constructed to assist in establishing the number of lamps per panel required to produce an "in-service" illumination level of 25 ft-c and to determine the opacity of the diffusing medium for uniform illumination across each panel. The "mock-up" was designed to permit rapid interchange of panels, variations in lamp to panel clearance and changes in interlamp spacing.

Since the control room was to be 71 ft long, 40 ft wide and was to have a suspended ceiling height of 11 ft, the shortest dimension of the room would be very nearly four times the ceiling height. Under these conditions and with surrounding surfaces having a high reflectance a relatively high room utilization could be expected. In addition, the proportions of the cavity above the ceiling would be more favorable to high light utilization than in the "mock-up". Weighting these two factors, it was obvious that any calculations employing test data obtained from the "mock-up" would include an adequate factor of safety.

After verifying the fact that footcandle readings would be constant when the distance from the point of measurement to the luminous surface was held to within one-fourth the surface width, tests were conducted with "Plexiglas" panels ranging in light transmission from 42 to 59%.

Plexiglas Performance

From these tests the following ceiling specification evolved:

a. Lamp to panel clearance—17½ in.

b. Number of tubes per panel—Two

c. Tube spacing (centered on panel)—14 in

d. Painting of cavity—80% reflectance or better

e. Panel density — Transmission 59%; Absorption 1%

f. Effect of cavity obstructions—Negligible

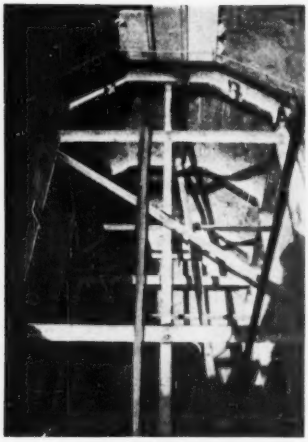
g. Effect of lamp reflectors—Negligible

With the surface of panels grit-sanded to prevent specular reflection, and with the "mock-up" arranged in accordance with the above specifications, a maximum variation in light output measured across the panel surface was 4%. Based on readings taken under these conditions, an "in-service" room illumination level of 23 ft-c was indicated. While this level was 8% below the design level, it was felt that improved utilization of the cavity and of actual room would raise the level to the value required. This has been realized; the actual installation having an initial utilization of approximately 40%.

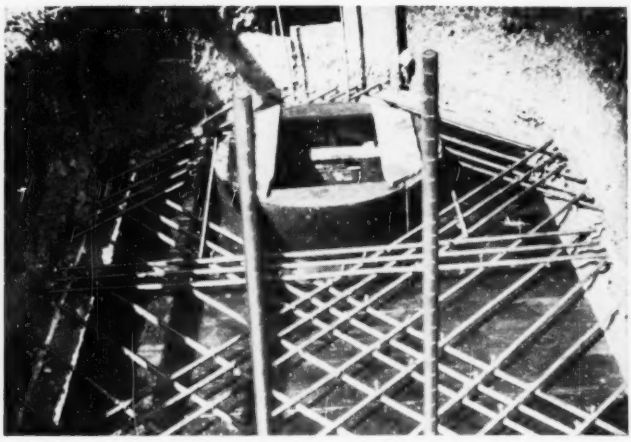
Companion Measures

In keeping with good lighting practice, all control panels were painted opalescent gray, the instruments were equipped with non-glare glass, side walls were finished in buff tile and a floor covering having 37% reflectance was specified. Emergency lighting was provided in the form of projector lamps located above the ceiling. These were connected to remain dark until a voltage reduction sufficient to cause failure of the cold cathode equipment was experienced. Provision was made in the framing steel to accommodate ventilating air inlets and the cavity above the framing was designed to serve as a plenum chamber for return air. Return air grills were located in the aluminum border which trimmed the frame to the walls of the room.

It is felt that this installation represents a definite advance towards the ultimate in lighting generating station control rooms and similar areas. With an initial illumination level of 52 ft-c no disagreeable glare has been experienced. The ceiling as installed is producing substantially shadowless illumination and the use of non-glare glass in the instrument lenses has been a definite aid to visibility. In this particular installation the luminous plastic ceiling using series cold cathode lamps has provided the best combination of reasonable installation cost, low maintenance cost, high operating efficiency and comfortable, accurate seeing.



1 REUSABLE STEEL FORMS that made construction easier are shown in place, floor has been poured and the steel placed



2 MANHOLE ROOF form and roof steel in place. Wood forms were developed for roof because they were easier to get out of manhole opening when job was completed. Concrete manholes proved cheaper than brick walled manholes and required less construction time

Methods That Save 20% On Underground Construction Job

Increased manhole spacing, standardized manholes and reusable forms, machine excavating, pneumatic gun for rodding ducts and assembly-line construction methods contribute to cutting of costs

JOE L. BARKER
Design Engineer
Oklahoma Gas & Electric Co, Oklahoma City

IN AN EFFORT to reduce the constantly increasing cost of construction and to expedite job completion, construction methods were studied and cost reduction measures applied on an underground job recently completed by the Oklahoma Gas and Electric Co. As a result the job cost was only 80% of the original estimate.

At least eight factors contributed to cost and time savings on this three-mile link to a distribution substation from Huey Generating Station.

1. Manholes Spaced At 750 Ft

A 9-duct run of 4-in. fibre conduits encased in concrete, three ducts wide by three high was chosen. Manholes were placed far apart, the spacing being 750 ft on centers where conditions permitted. Deciding factors in manhole spacing were duct drainage and cable pulling.

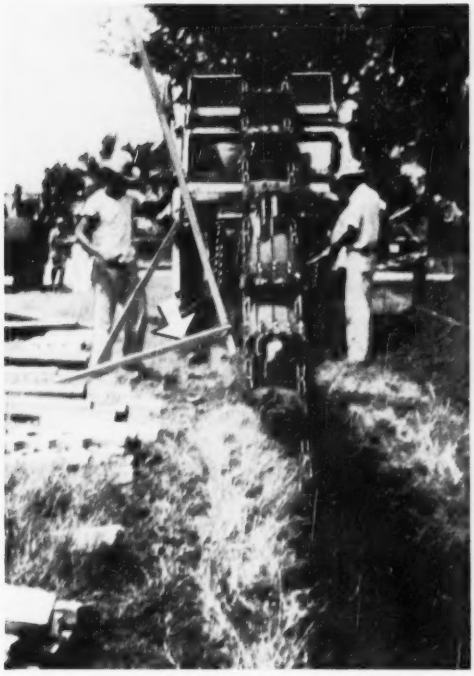
Cable selected was 500 Mcm, a conventional solid type, compack strand, paper-insulated, lead-sheathed 15,000-v, single-conductor, with three cables in one duct. With no experience in long cable pulls it was felt that manhole spacings of 750 ft would be conservative, but would effect substantial savings over the 400 to 500-ft spacings previously used on duct runs in more congested areas.

2. Standard Manholes, Reusable Forms

Manhole construction was standardized, and reusable forms were developed for concrete walls, roof slab, and duct bulkheads.

Concrete manholes are definitely cheaper and require less construction time than brick walled manholes.

Two types of manholes were developed, four-way and two-way. Each type was octagonal. Four-way manholes had 27-in. duct entrance walls and 54-in. splicing walls. Two-way holes were 10 ft-0 in. between 27-in. duct entrance walls and 5 ft-3 in. between 84-in. side splicing walls. End and side walls were joined by corner walls at 45 deg. Head room in both types of holes was 7 ft-0 in., with the varying manhole depths taken care of by the length of the circular brick neck between the roof slab and the 33 in. manhole cover at surface grade. For the two-way manholes, the manhole entrance was placed near one end of the hole to simplify cable pulling.



3 LIGHT DITCHING MACHINE cut 22 to 24-in. ditch 8 ft deep. 90-deg straightedge (arrow) was used to check and correct bottom of ditch elevation by means of grading string at right of ditch

4 DITCHING MACHINE went straight through manhole, aligning the hole and excavating approximately one-fourth of the manhole. Ditch behind machine was cleared and squared by one or two men

Steel panel inner wall forms and braces were developed which could be placed and removed by hand. Steel bulkhead forms and duct guides were made to facilitate duct termination and to recess the duct ends 6 in., thus effectively lengthening each manhole 12 in. for cable bending, and allowing the cables to follow the walls with less bending at the duct ends. Wood panel forms and braces were developed for the bottom of the roof slab, these being lighter to handle than steel, and easily removable through the manhole opening.

3. Obstructions Located In Advance

All available records were checked for obstructions along the duct route. These records are not always accurate, so the whole route was gone over carefully with a metallic line locator, an improvement of the mine detector devices used during the war. All known metallic obstructions were accurately located with the locator. Several others were found which were not even suspected. Non-metallic obstructions, such as sewer line crossings, were located and depths determined from city records and from field checks conducted at the closest sewer manholes.

Excavations for duct runs were made to final grade with a ditching machine wherever possible.

4. Use of Machine Excavating

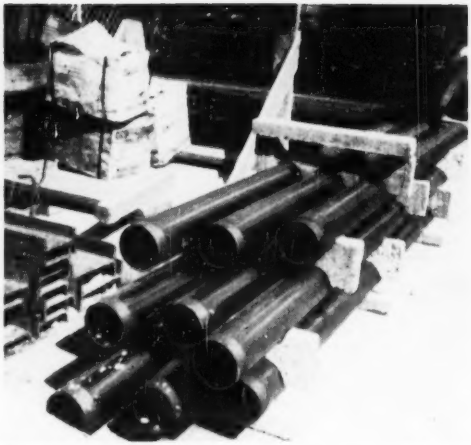
Major portion of the duct run followed an abandoned street railway right of way, unpaved except at street crossings. Of the approximate 14,000 ft of duct run installed, about 13,000 ft of ditch was machine excavated. Included in the construction drawings was a complete profile of the bottom of ditch elevations, with grades established on the basis of minimum excavation which would provide adequate duct coverage (to avoid high ambient temperatures from sun heat), satisfactory drainage, and clearance from obstructions. In the field, obstructions which might affect ditch grades were exposed by hand digging well ahead of the ditching machine, and ditch grades were revised as necessary on the profile drawing before excavation. This eliminated considerable actual ditch regrading, enabled the ditching machine to work extremely close to obstructions on both sides, and provided an accurate record of the installed duct run elevations.

A comparatively light ditching machine which would cut a 22-in. to 24-in. wide ditch some eight feet deep was used for all but two cuts. Average depth of excavation was about 5 ft-6 in. Depth of excavation was carefully controlled, and only one or two men were needed to clean out and square off the bottom of the ditch behind the machine. Two cuts, each about 150 ft long, were made with a heavier machine, since these required excavation ranging to 16 ft in depth.

5. Duct Spacers Made In Quantity

Thousands of duct spacers were required for the project. These were

5 **TEMPLETS** on this table permitted two men, with small concrete mixer to turn out 500 3-duct spacers each 8-hr working day



6 **CONCRETE DUCT SPACERS** like these were used by the thousands for the three miles of 9-duct run of 4-in. conduit

made and delivered at minimum cost by our own construction forces. Templets were sawed out of 2 in. thick lumber and fitted into notched sideboards on pouring tables. Spacers were reinforced with a single length of $\frac{1}{4}$ in. iron wire to minimize breakage in handling. Two men with the aid of a small concrete mixer were not rushed to make 500 of these 3-duct spreaders each 8-hr working day. To coordinate this with other work, production of spacers was started well in advance of the duct construction.

6. Pneumatic "Gun" to Swab Ducts

It has been our practice to check all duct runs with a combination swab and mandrel before any cables are installed, to be sure that all ducts are usable.

To save time in doing this, a pneumatic device was designed and built by the operating forces for getting lines through the completed duct runs. A gun was made, the forward end of which slipped into the duct end and was locked in place, air tight, by compression of a rubber sleeve. The rear end of the gun had a tapered opening for a $\frac{3}{32}$ in. stranded steel airplane control cable. An air compressor fitting with valve was attached to the gun barrel. The projectile, pushed into the duct ahead of the gun, was a threaded steel rod to which were attached two cups cut from the proper sized dime store rubber ball. The steel cable was threaded through the gun and attached to the projectile and the compressed air forced it through the duct. Projectile velocity of about 200 fpm, controlled by the air valve, was found to be very satisfactory.

After the $\frac{3}{32}$ in. steel cable was fished through the duct, a duct swab was attached to the far end of the cable. The near end of the cable was run through a sheave in the manhole and attached to another projectile. As this second projectile was forced through an adjacent duct it pulled the duct swab back through the first duct. With this procedure some 130,000 ft of duct were swabbed in record time. Lines for cable pulling were installed with the same device.

7. Small Crew Pulls 4,500 Ft Per Day

Cables were ordered cut to length, in triplex spiral arrangement, and with pulling eye attached. Each reel of cable contained one pulling length for a particular location, so it was a simple matter to spot reels at proper manholes. A small cable pulling crew was able to set up reels for turning, strip off lagging, install pulling lines, and pull in six lengths, or approximately 4,500 circuit-ft, of cable each day. The triplex spiral arrangement of cables made the three cables perhaps easier to pull in than an equivalent 3/C cable. Cables were greased as they were drawn in, and pulling tensions were carefully checked. With a 750-ft length of cable in place, starting pull was 2,000 lb average, and tension on moving cable 1,500 lb average.

8. Adopt Assembly-Line Methods

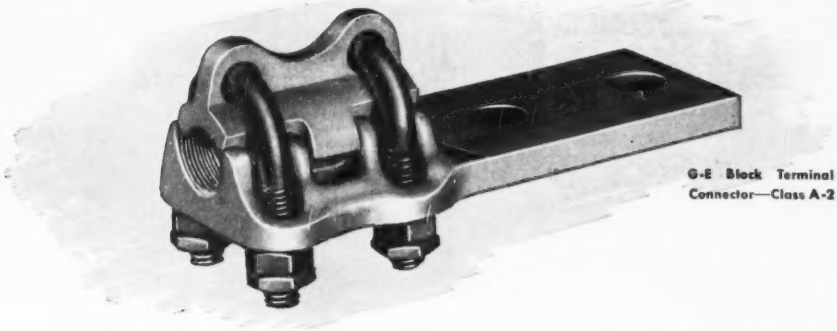
It has been proved that standardized construction, or repetitive construction, reduces costs. To illustrate: a crew of five men, after they had constructed several identical manholes on this project, accomplished the following: working on several manholes in various stages of completion, they set the sump and floor steel and poured and finished the concrete floor of one manhole; they placed and tied the wall steel on another manhole, set the steel wall forms and poured the walls; on another manhole they set up the roof slab forms, placed and tied the steel, and poured the roof slab; on still another manhole they built the brick manhole neck and installed the frame and cover—all in one 8-hr working day.

Limiting factor in duct construction was availability of concrete, which limited the 9-duct installation to 400 to 500 ft per day.

Save 20%

No detailed comparative cost analysis has been made to determine the actual dollars or manhours saved but by utilizing the above cost-saving methods the overall cost of the completed job amounted to 80% of the estimated cost, which was contrary to the usual trend, and most satisfactory to all concerned.

This General Electric power connector can simplify your inventory by 63% to 83%



G-E Block Terminal Connector—Class A-2

Five General Electric power connectors of the type shown above will handle *all* the 22 conductor sizes listed in the table*. Compare this feature with other brands that usually *require a different connector for each conductor size.* You'll immediately realize how much G-E connectors can cut your stock costs by reducing the number of connectors required.

Here are other ways you can SAVE by using G-E connectors.

SAVE TIME—No more stock room safaris hunting for odd-size connectors. When you stock General Electric connectors, you stock fewer connectors. Also, you save time in ordering—you don't have to search through bulky catalogs looking for connectors that are seldom used and are a nuisance to order, besides taking up valuable stock space. G-E connectors are easy to order for the simple reason that you don't have to order so many varieties.

SAVE SPACE—Less stock room space required when you use G-E connectors because fewer connectors are needed to take care of the same range of conductor sizes that you're using now.

SAVE MONEY—When you use G-E connectors you reduce stock storage costs, and you save valuable time in ordering.

CHECK THESE ADDITIONAL FEATURES OF GENERAL ELECTRIC CONNECTORS

SILVER CONTACT SURFACES are a *standard* feature on *all* G-E connectors for use with copper conductors—at no extra cost. This eliminates oxidation problems, assures lower contact losses and longer life.

SERRATED CONTACT SURFACES give extremely high pull-out strength and a permanent, high-conductivity joint that will resist vibration and give positive pressure on the cable at all times.

NON-CORRODIBLE HARDWARE is of high-strength bronze alloy that gives tight and trouble-free service. G-E connectors will not twist, distort, or season crack.

INTERLOCKING SIDES confine the strands of the cable within the conductor enclosure, thus obtaining full advantage of the cable's current-carrying capacity.

Place an order today with your G-E sales representative and start realizing the many benefits to be gained by using this new line of General Electric connectors. Also, write for a copy of bulletin GEC-400 that contains 38 pages of valuable information on these new connectors, and see for yourself how easy they are to order. Write to *Apparatus Department, Section L856-51, General Electric Company, Schenectady 5, New York.*

*General Electric connectors come in a wide range of sizes and types—straight, tee, block, angle, parallel, expansion, ground, and many others. See bulletin GEC-400 for the complete line.

Conductor size	General Electric Catalog No.	Connector Mfg. A	Connector Mfg. B	Connector Mfg. C	Connector Mfg. D
1/0	6151174-9 One G-E connector replaces 6, stock is reduced 83⅓%	√	√	√	√
2/0		√	√	√	√
3/0		√	√	√	√
4/0		√	√	√	√
250		√	√	√	√
300		√	√	√	√
350	6151174-59	√	√	√	√
400		√	None	√	None
500		√	√	√	√
600		None	None	√	√
½ IPS		√	None	√	√
700	6151174-88	None	None	√	None
750		None	None	√	√
800		None	None	√	√
1000		None	None	√	√
¾ IPS		√	√	√	√
1250	6151174-113 One G-E connector replaces 3, stock is reduced 66⅔%	None	None	√	√
1500		None	None	√	√
1 IPS		None	None	√	√
1750	6151174-148	None	None	√	√
2000		None	None	√	√
1¼ IPS		None	None	None	√
Only 5 G-E connectors for All 22 conductor sizes		11 connectors for 11 cond. sizes. No connectors available for 11 conductor sizes	9 connectors for 9 cond. sizes. No connectors available for 11 conductor sizes	21 different connectors for 21 cond. sizes	20 different connectors for 20 cond. sizes

√ Indicates a different connector.

GENERAL ELECTRIC

H56-51

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN

Portable Capacitor Trailer Cuts Maintenance Costs

A. S. BRIGGS
Philadelphia Electric Co
Coatesville, Pa.

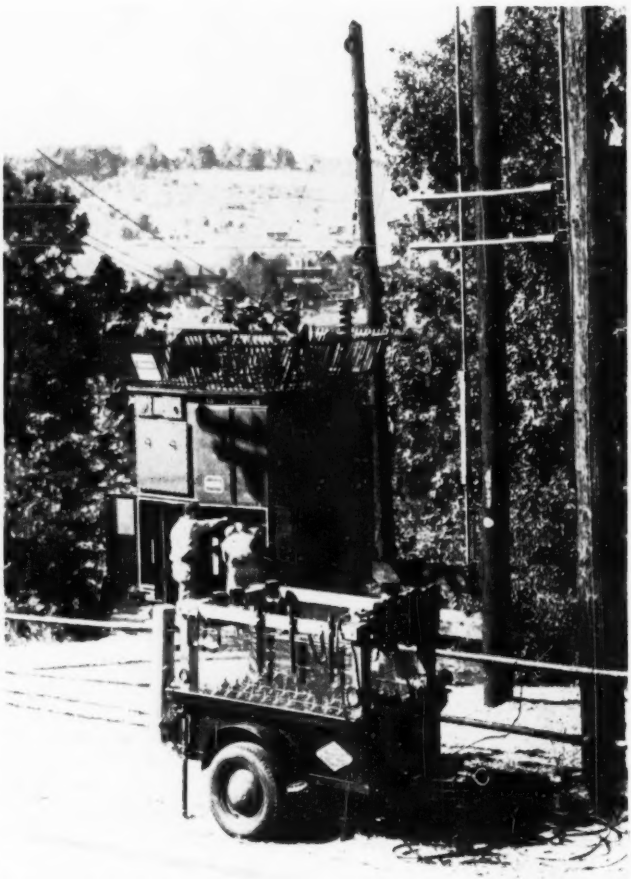
THE TREND toward heavy loading of conductors and substations has made it increasingly difficult on the Philadelphia Electric Co system to remove substation and associated equipment from service during the normal working week for the Doble testing, relay calibration, routine inspection and overhaul. Saturday or Sunday shutdown, although unavoidable in certain substations, was undesirable both from the standpoint of increased cost and increased Sunday work schedule. Several ways for removing these substations from service during the normal work week were considered before it was decided to build a light portable shunt capacitor trailer that could be set up near the substation site to offset the voltage drop caused by removing the particular substation from service.

The arrangement used is shown herewith. It comprised a ¾ ton, two-wheel trailer with 24-15-kva, 2,400-v shunt capacitor units installed so that variable units could be connected from 15 kva to 120 kva per phase on either 2,400-v delta or 4,000-v wye systems by changing removable copper bars. Connection is made to the line through 100-amp fused cut-out boxes, 5,000-v rubber covered wire and mechanical jumper sticks. The trailer is enclosed by a grounded wire mesh. Total weight including trailer is 2,150 lb.

To place the trailer in service, it is only necessary to drive a ground rod, attach the ground wire to the 4-kv neutral, connect the jumper sticks to the phase wires, and close the cutout boxes.

This capacitor trailer has been used extensively since 1947 to effect removal of substations from service during the normal working week with resultant substantial cost reduction. The average voltage rise resulting from its use has approximated 14%.

Several times where interruptions have occurred to radial transmission lines feeding a single substation it was used to raise the voltage on the interrupted substation circuit from unsatisfactory to satisfactory levels until permanent, rather than temporary, repairs could be made.

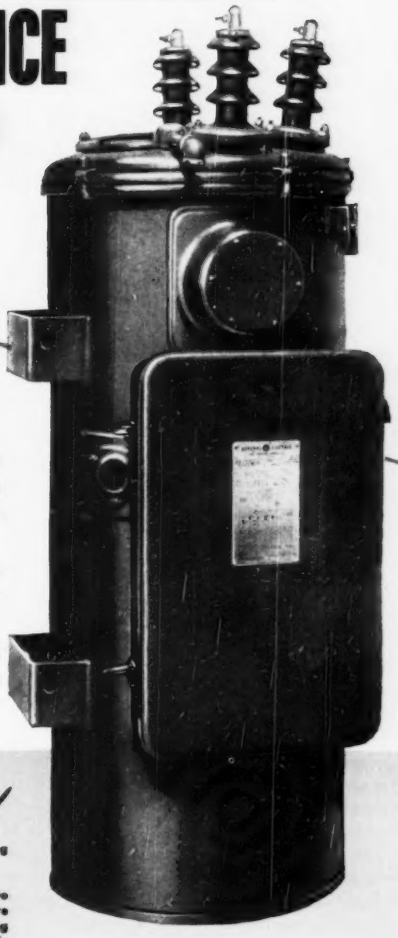


CAPACITOR TRAILER set up near substation site offsets voltage drop caused by removal of station from service for maintenance. An overall saving will result from permanent repairs

NOW

AN 8-STEP REGULATOR FOR THE PRICE OF A 4-STEP

General Electric's New ML8



This is General Electric's new ML8 Step Voltage Regulator. It supersedes the 4-step ML4—at no increase in price. It provides 10% automatic voltage regulation, in eight 1¼% steps—which means better service on rural feeders.

Closer regulation, smaller steps, increased capacity, widens the field of application to urban fringe areas at low installed cost and with minimum maintenance.

Booklet GEA-5417, just off the press, gives full information. Ask your local G-E office for a copy, or write to *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

Better Construction than ever before!

The shockless, snap-action Geneva gear drive—similar to the time-tested type ML4—assures accurate, positive positioning of contacts in the ML8. It has an improved switching circuit, employing the same bridging reactor principle as used for tap changing under load on large power transformers. The need of lubrication is eliminated because the complete switching mechanism, including the operating motor, is oil-immersed.

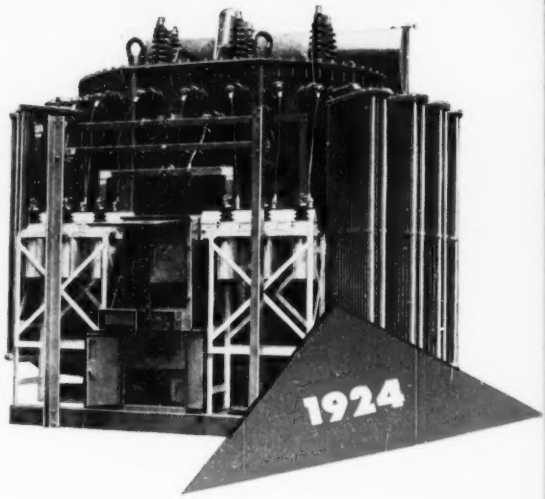
Control cabinet is now identical to that used with the more expensive IRS induction regulator, including shelf which locks door open while providing a handy place for portable instruments. Cabinet may be mounted separately if desired.

GENERAL ELECTRIC

Look what's

to load ratio

It's a far cry from this transformer, built in 1924, to the 1949 design on the opposite page. The obvious difference is the much better appearance. But of more significance are the internal improvements.



That transformer of 25 years ago was the start toward making load-ratio-control as reliable as the transformer itself. In it, tap selector switches were used in combination with separate arcing and current-carrying contacts (external circuit breakers in 1924). About the same time, General Electric introduced the bridging of tap sections by a reactor having an air gap, thereby preventing dangerous overvoltages. These basic practices have made practical the large load-ratio-controlled transformers of today.

OTHER G-E ADVANCES

Other G-E introduced practices have also been generally adopted. Load-ratio control equipment is now designed to function properly under overload conditions. Sequence of operation of contacts and selectors is now mechanically interlocked. In larger transformers, arcing is confined to special contacts housed separately from the main tank. All in all, today's equipment for changing taps under load is so reliable that it can unhesitatingly be specified whenever needed. More than a third of all recently built large G-E transformers are so equipped.

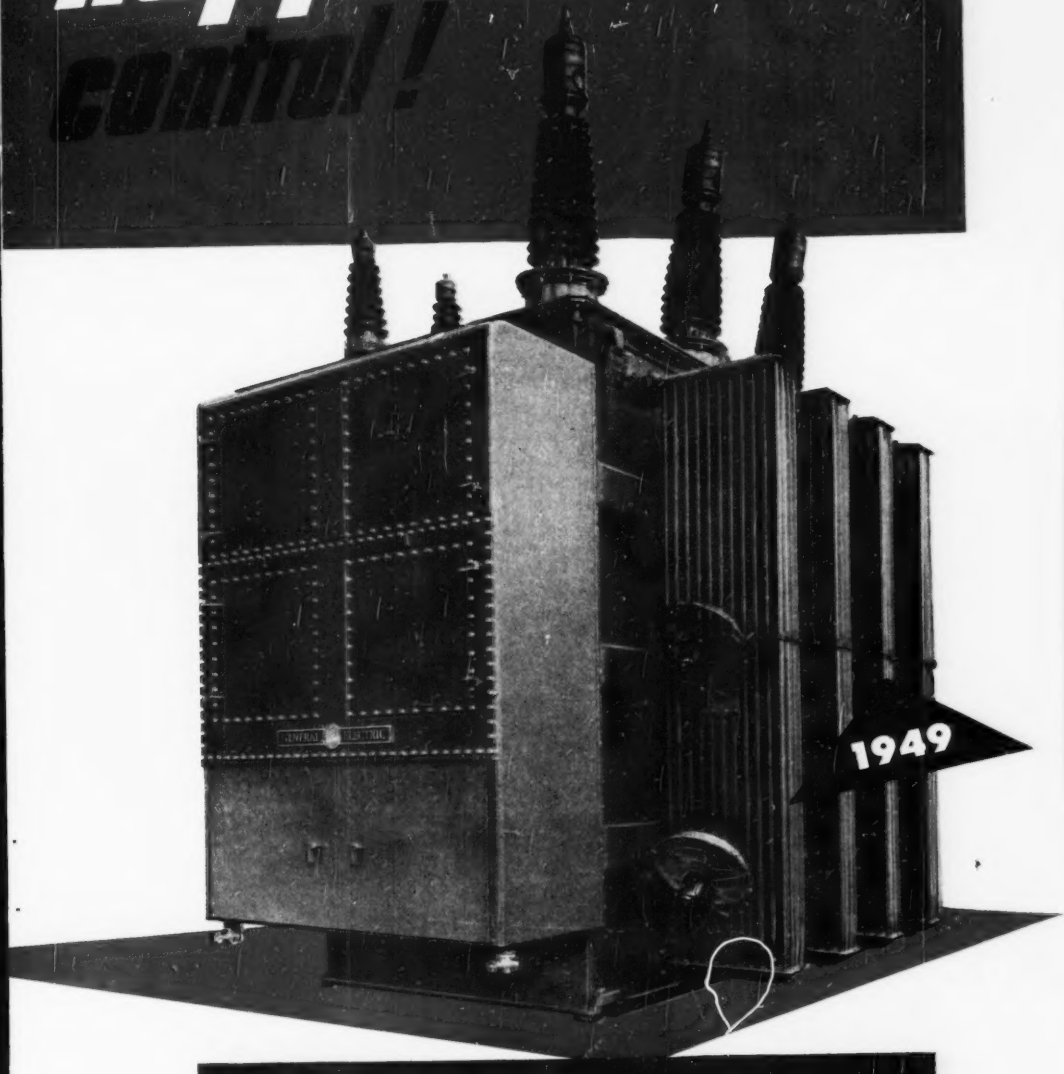
However, in our opinion it still takes experience to build such equipments—experience that can't be acquired in a short time. It has taken us 25 years to learn all we know about it—and the experience of building and watching the performance of almost 25,000,000 kva of such equipment.

We have perfected nine different mechanisms for various ratings of transformers to be sure that you get maximum reliability under all conditions—even after hundreds of thousands of operations. Thus, the story of load-ratio-control shows again that you can put your confidence in General Electric.

Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

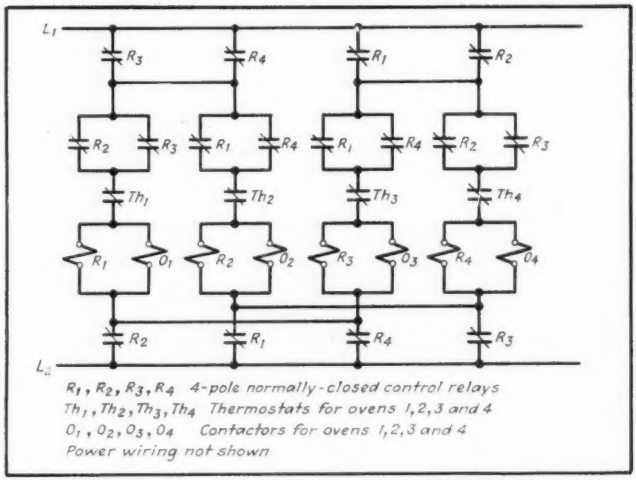
happened...

control!



GENERAL ELECTRIC

401-5


L_1
R_3 R_4 R_1 R_2
R_2 R_3 R_1 R_4 R_1 R_4 R_2 R_3
Th_1 Th_2 Th_3 Th_4
R_1 O_1 R_2 O_2 R_3 O_3 R_4 O_4
R_2 R_1 R_4 R_3
L_2
R_1, R_2, R_3, R_4 4-pole normally-closed control relays
Th_1, Th_2, Th_3, Th_4 Thermostats for ovens 1,2,3 and 4
O_1, O_2, O_3, O_4 Contactors for ovens 1,2,3 and 4
Power wiring not shown

CONTROLS for four thermostatically-controlled electric ovens to permit simultaneous operation of any two ovens—thus preventing any possible overloading of the feeding transformer

Four Ovens Fed with No Transformer Overload

FRANK E. REEVES
Power Plant Design Engineer
Barnard & Burk
Baton Rouge, La.

THIS SCHEME was devised to limit power demand and prevent overloading a 50-kva transformer feeding four electric ovens. The electric interlocking of the 4-pole, normally closed relays allows only two ovens to be energized at one time. With all ovens cold and all thermostats calling for heat (contacts closed), when I_1 and I_2 are energized, the relays will all try to operate. The two fastest relays will prevent the coils of the other two from being energized and also keep the two corresponding oven contactors from closing. The ovens associated with the two fastest relays will thus start to heat. When the first thermostat is satisfied, its relay and oven contactor will drop out. It will then be a race between the two remaining control relays.

After the third oven thermostat has been satisfied, the heating and cooling of each oven falls into a definite sequence. There should be but a slight delay before an oven contactor may close after its thermostat contacts close, the delay period being only the last part of the heating period of the oven which had, for the moment, the longest heating period of the four.

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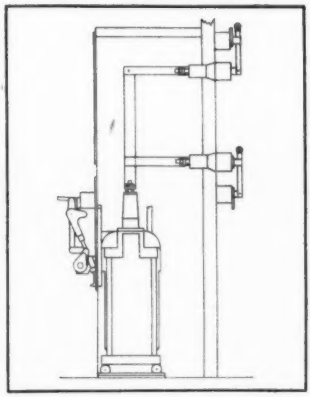
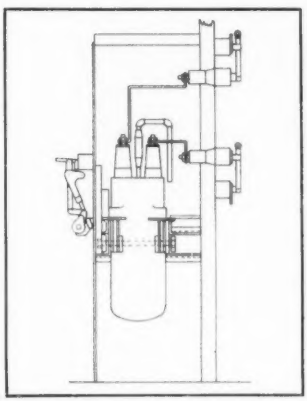
Truck-Type Breakers Rebuilt to Drop-Tank



COST of inspecting and overhauling these old-style, truck-type 13.2-kv oil circuit breakers (no bayonet disconnects) proved excessive



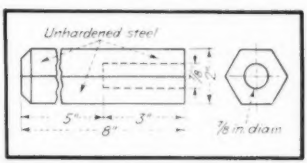
WHEN RELOCATED old-style breakers are rebuilt to the drop-tank mounting type thus reducing the cost of inspection and overhaul

S. M. HAMILL, JR
Manager Electric Operating Dept
The Cincinnati Gas & Electric Co
Cincinnati

COSTS OF OVERHAULING and inspecting the old truck-type 13.2-kv oil circuit breakers (without bayonet type disconnects) have proved high because it was necessary to remove tape and disconnect primary connections, disconnect the muffler pipe and disconnect control wiring before work

For Easy Driving of Copperweld Ground Rods

TO FACILITATE driving copperweld ground rods, Henry J. Credit of the Worcester Suburban Electric Co, Millbury, Mass., developed the tool illustrated. It is designed for use in connection with ¾-in. rods, and is essentially a hexagonal bar of unhardened steel 8 in. long and 2 in. in surface-to-surface diameter. A ¾-in. hole extending 3 in. into the bar from one end provides for seating the rod while driving with a heavy hammer against the head end. This protects the copperweld from being knocked out of shape by the hammering, and tends to enable faster work to be done as a result of the increased stability.

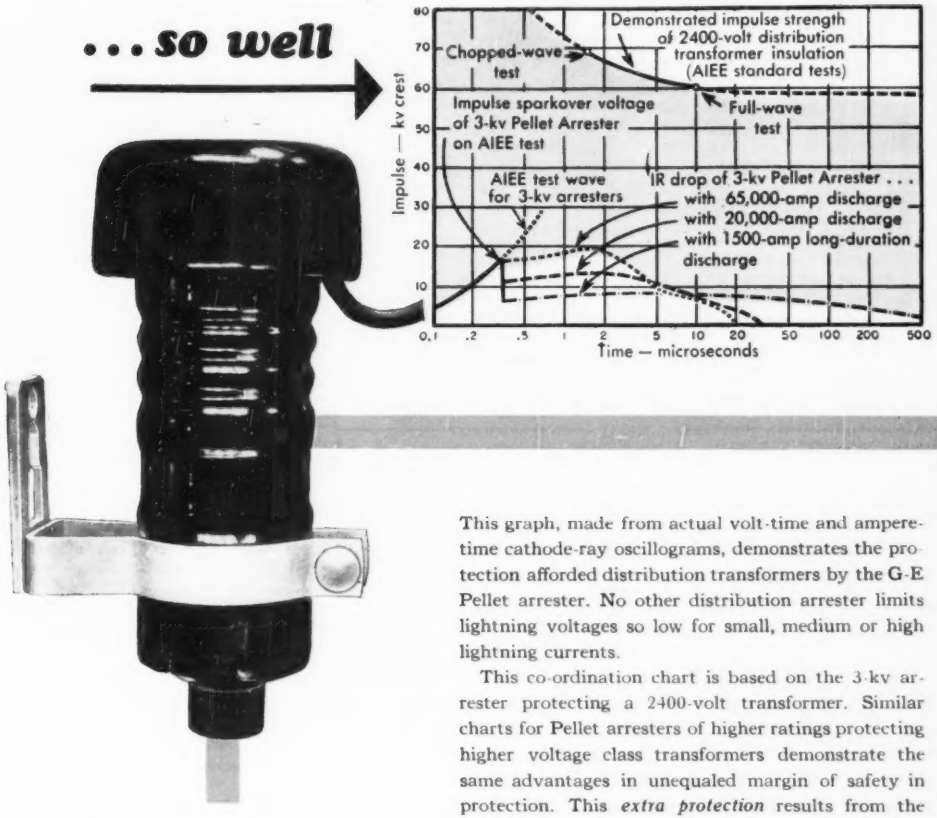


TOOL FOR DRIVING copperweld ground rods lends increased stability during hammering and prevents distorting the copperweld

No other distribution arrester

Protects

. . . so well



The G-E Pellet arrester is also "tops" for endurance. It is the only distribution arrester with series gaps sealed in dry, inert nitrogen (N_2)—keeping gap electrodes bright as new during years of service operation. Pellets, themselves, are of lead peroxide—a distinctive valve element, self-protecting against service moisture—unaffected by condensation, or humidity. Pellet arresters have large discharge capacity—they withstand easily the AIEE and NEMA standard 65,000 ampere impulse test.

This graph, made from actual volt-time and ampere-time cathode-ray oscillograms, demonstrates the protection afforded distribution transformers by the G-E Pellet arrester. No other distribution arrester limits lightning voltages so low for small, medium or high lightning currents.

This co-ordination chart is based on the 3-kv arrester protecting a 2400-volt transformer. Similar charts for Pellet arresters of higher ratings protecting higher voltage class transformers demonstrate the same advantages in unequaled margin of safety in protection. This *extra protection* results from the combination of low sparkover voltage and exceptionally low IR drop, that together hold lightning voltages to lower levels than does any other distribution arrester.

You buy better protection when you buy Pellet arresters! The Quality-Standard of the Industry for more than 25 years.

Apparatus Department, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

could be done. Work could only be performed on one phase at a time and with the mechanism supported by a chain fall or other non-rigid support. When completed these steps had to be reversed.

Rebuilt to Drop-Tank Type

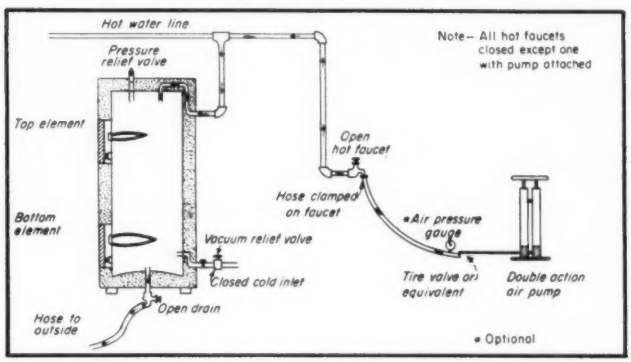
Now when these breakers are moved to new locations they are being rebuilt to the drop tank mounting type. This enables inspection and adjusting by merely dropping tanks and performing necessary work with the operating mechanism and contacts in place. This also permits checking coordination between phases with the tanks lowered.

The old style and its rebuilt counterpart are shown.

Two six-inch channels are supported by the side walls of the breaker cell, one running in front of the breaker tanks, and the other in the rear. One-half inch thick iron plates are welded to the main casting and are bolted to the six-inch channels to support the breaker. The original tank clamping bolts are cut down and welded to the tank sides. These fit in the original holes in the main castings to support the tanks. Cast iron spacers are placed between the main casting and the operating mechanism supporting casting to bring the operating mechanism out in front of the cell. This requires lengthening the horizontal operating pull rods. An 11-gauge steel plate is placed between the operating mechanism and the supporting casting of the mechanism to form part of the metal enclosure above the breaker.

Experience with the rebuilt breakers has shown that the cost of rebuilding has been more than justified.

Speeding Drainage of Electric Water Heaters



AIR PUMP attached to hot water line forces water out of heater and saves much time and effort in servicing when it is necessary to drain the tank, as for replacing heating elements

D. K. HOLLAND
Narragansett Electric Co
Westerly, R. I.

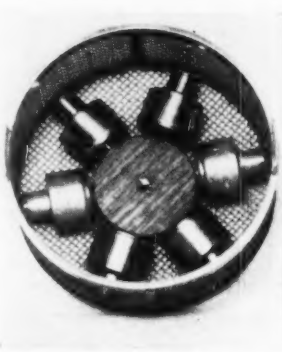
In servicing electric water heaters—replacing heating elements, for instance—it is frequently necessary to drain the tank. Much time can be saved by forcing the water out under pressure and flowing it off through a hose to a drain point.

The usual method of draining the heater is to open the drain valve and let the water flow out by gravity, carrying it outside by the bucketful.

The pressure necessary to force out the water can be applied with a double-action, hand operated air pump connected to a convenient hot water faucet of the unit set-up. All hot water outlets other than that to which the pump is connected should be closed.

If the system has a hot water cut-off valve near the heater, closing this will save a lot of pumping; otherwise the piping will become filled with air as the water in it flows back into the tank.

Drying Telechron Rotors



SIX ROTORS and wood block holder are fitted into basket ready to be placed on machine where rotating motion will dry rotors by centrifugal force in a matter of minutes

To speed the drying of telechron rotors, Dallas Power and Light Co's metermen devised a scheme for placing them, 6 at a time, in the wire basket of a regular watch cleaning machine which is used for washing meter parts and rotating this basket on the machine, drying the rotors by centrifugal force. Key to the scheme was an oak block one-inch thick and 2¼ inches in diameter with six holes drilled in the edge equidistant around circumference of the block. These holes were just large enough to take the shaft of the telechron rotor and deep enough so that when the six rotors were inserted around the circumference of the block the entire assembly fitted into the wire basket of the meter parts cleaning machine.

Burner Repairs Save $36

Each gas burner tip at Ripley Plant of Kansas Gas and Electric Co contains 16 holes, each 11/32 in. in diameter. Wear and corrosion of these holes affect combustion, requiring burner replacement at $56 each.

Now, these tips are being repaired by building them up with stainless steel rod in the area containing the holes, after which the holes are redrilled. Cost is about $20 for repairing—a saving of $36 per burner.

What a Cold, Calculating Beating this Lug takes!

IT'S NEW! IT'S DIFFERENT! IT'S MADE OF REVERE COPPER —The "Double G" Solderless Lug made by THE GREGORY MANUFACTURING CO., INC., New Haven, Conn., for the electrical field, comes in 6 sizes to accommodate from 14 ga wire to 1,000,000 CM cables. Pressure screws are steel.

HOLD 'EM TIGHT—These sharp, deep-cut serrations on inside of both tubular sections and projection tang help to make firm, non-slip joints possible. They also increase the rigidity and conductivity of the connection. Note that these serrations were made cold, and without any distortion of the Revere Copper used. Lugs shown are twice actual size and are unretouched.

...and not a Scar to show for it!

Improved solderless lug of hard drawn Revere Copper, cold worked over and over without distortion, cracking, pitting or scarring.

Pierced, formed at short 45 degree and 90 degree angles and deeply serrated, this "Double G" solderless lug really gets a working over . . . and cold, too, no annealing. Yet, with all this, the surface remains absolutely smooth, the lug is not in any way weakened and there is no twisting, pitting, cracking or scarring of any kind. And, in addition, its dimensions are held.

When the Gregory Manufacturing Co., Inc., was developing this solderless lug, with its unusual features, it had a problem on its hands.

Their design called for copper strip that could stand a lot of cold working and when finally fabricated into a product of uniform quality, would not have a lot of twist, cracks, pitted or scarred surface. In their efforts to secure such a product their engineers had frequent consultations with Revere's Technical Advisory Service. The result was the product shown and described above, with production time and money saved and rejects held to the vanishing point. The material used was Revere hard drawn copper strip with a temper of 36 to 46 Rockwell B Scale. This company feels that they could not have developed such a successful product if the quality of the copper was not of the best and did not possess the inherent working characteristics needed.

Perhaps Revere Copper or some other Revere Metal can be of help in developing or improving your product—cutting your production costs. Why not tell Revere's Technical Advisory Service about your metal problems? Call the Revere Sales Office nearest you today.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

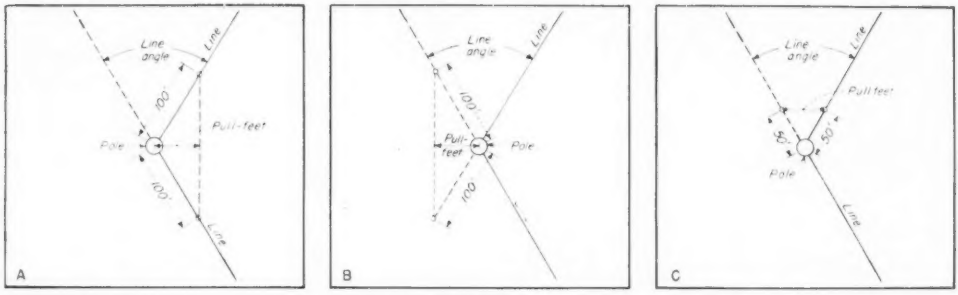
• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

Allowable Line Angles up to 60 Deg

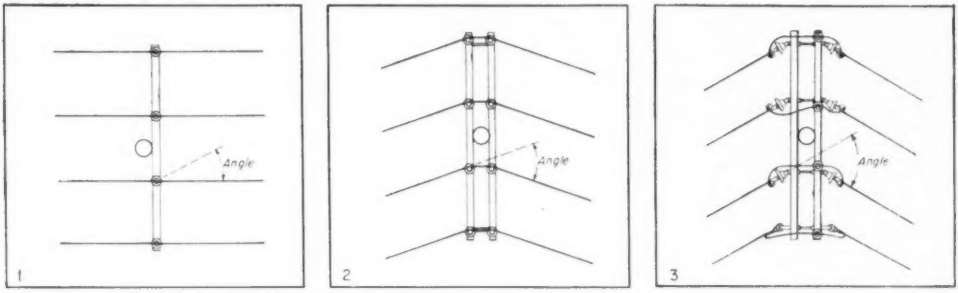
An adaptation from construction methods of Pacific Power and Light Co, Portland, Oregon

Method of Determining Pull-Feet at Angles in Line



PREFERRED METHOD **ALTERNATE METHODS** in case of obstruction

Line Angles for Single-Arm and Double-Arm Supports



Line Angles for Various Conductors and Supports

Size of Largest Conductor	Maximum for Fig 1				Maximum for Fig 2				Min. for Fig 3	
	Wood Pins		Steel Pins(a)		Wood Pins		Steel Pins(b)		Angles up to 60 deg or 50 "Pull" ft for which this construction applies(c)	
	Line Angle		Line Angle		Line Angle		Line Angle			
	Pull-Ft	Deg	Pull-Ft	Deg	Pull-Ft	Deg	Pull-Ft	Deg	Pull-Ft	Deg
URBAN										
6 Cu	21	24	42	50	42	50	50	60	. . .	. .
4 Cu	16	18	32	37	32	37	50	60	. . .	. .
2 Str Cu	12	14	24	28	24	28	50	60	. . .	. .
1 0 Str Cu	8.8	11	17	20	17	20	34	40	34-50	40-60
2 0 Str Cu	7.3	8	15	17	15	17	30	35	30-50	35-60
4 0 Str Cu	5.2	6	10	12	10	12	20	23	20-50	23-60
RURAL										
6 Cu	15	17	30	35	30	35	50	60	. . .	. .
4 Cu	10	12	20	23	20	23	40	47	40-50	47-60
2 Str Cu	6.7	8	26	30	13	15	50	60	. . .	. .
1 0 Str Cu	4.9	6	10	12	10	12	20	23	20-50	23-60
6 Steel										
3 Str 130	4.5	6	9	10	9	10	18	21	18-50	21-60
8 Steel										
3 Str 130	6.7	8	13	15	13	15	26	30	26-50	30-60
8A CW	8.7	10	17	20	17	20	34	40	34-50	40-60
6A CW	7.5	8	15	17	15	17	30	35	30-50	35-60
4A CW	5	6	10	12	10	12	20	23	20-50	23-60
4 ACSR 6 1	11	12	22	26	22	26	44	52	44-50	52-60
2 ACSR 6 1	7	8	14	16	14	16	28	32	28-50	32-60
4 ACSR 7 1	8.5	10	17	20	17	20	34	40	34-50	40-60
2 ACSR 7 1	5.5	6	11	13	11	13	22	26	22-50	26-60

NOTES

1. Straight line methods apply up to line angles of 5 deg (4.5 pull-ft) and corner construction methods apply for line angles greater than 60 deg (50 pull-ft).

2. It is better construction and more economical to run lines straight and then make a large angle turn than to make several small angle turns.

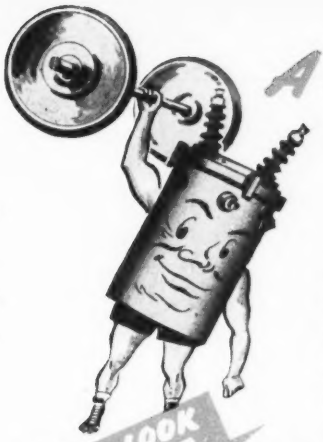
3. Method for determining line angle in pull-feet, for conductors other than listed in table, use following:

Pull-feet = 11,700/T for one wood pin
= 23,400/T for one steel pin
where T = maximum loaded tension of largest conductor on crossarm.

4. Guys are necessary where pole strength is not adequate.

Footnotes to Table

(a) Use same data for one pole top pin.
(b) Use same data for two pole top pins.
(c) Based on maximum for two steel pins. If steel pins and corresponding arms are not available use maximum value shown for two wood pins.

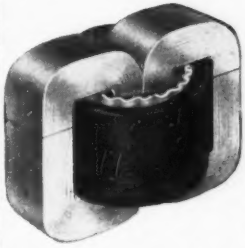


A smaller package for a BIGGER Job!

They say good things come in small packages. In the case of Moloney HiperCore Transformers, it's true! Though much smaller in size and lighter in weight, HiperCore Transformers have greater short-time overload capacity, better voltage regulation and are much more dependable for all-around sustained performance. Averaging ⅓ smaller in size and weight, HiperCore Transformers have improved characteristics, which will be reflected in your maintenance and operating records.

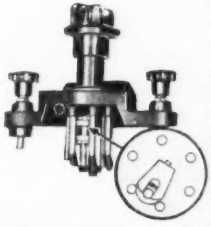
LET'S LOOK INSIDE

HiperCore Transformer cores are wound from oriented, silicon steel. Each loop is annealed in its final form and individual laminations do not have to be disturbed for assembly, assuring top performance of unstressed core steel. Annealed core loop is impregnated with high temperature plastic binder which makes possible cutting into two U-shaped pieces. Cutting burrs are neatly removed by etching.

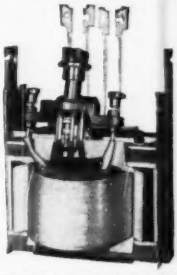


The core-and-coil unit is a center-leg type of construction, having a single coil and two core loops. Each core loop is cut into two U-shaped pieces after impregnation, and then cemented back together when the coil is in place. Steel bands around each core loop hold the two U-shaped pieces tightly together with a force of from one to three tons.

The Moloney HiperCore Tap Changer is unmatched in ruggedness and design. The plainly numbered operating handle is located *above* the hot oil level. Double-wedged contacts snap into place with a wiping action. Sturdy beryllium copper springs provide high pressure contact.



The complete core-and-coil unit for a HiperCore Transformer is the last word in compact design and superior performance. Simplicity of design plus liberal use of materials and adequate cooling ducts combine to make HiperCore Transformers cooler operating and better performing, resulting in longer life under normal operating conditions.



Plus FEATURES

- ✓ Lower Hottest-spot-over-oil temperature
- ✓ Longer Operating Life
- ✓ High Factor-of-Safety in Design
- ✓ Lighter Weight
- ✓ Smaller Size
- ✓ Greater Short-Time Overload Capacity
- ✓ Better Voltage Regulation
- ✓ Superior Tap Changer

Send for Bulletin H-303 describing HiperCore Transformers.

MOLONEY

ELECTRIC COMPANY

Sales Offices in all Principal Cities

FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONTARIO, CANADA

Transformer Voltage-Drop Curves

TRANSFORMER VOLTAGE-DROP CURVES: % Drop = F x % Transformer Impedance

WILLIAM JOSEPH
Electrical Engineering Division
American Gas & Electric Service Corp
New York, N. Y.

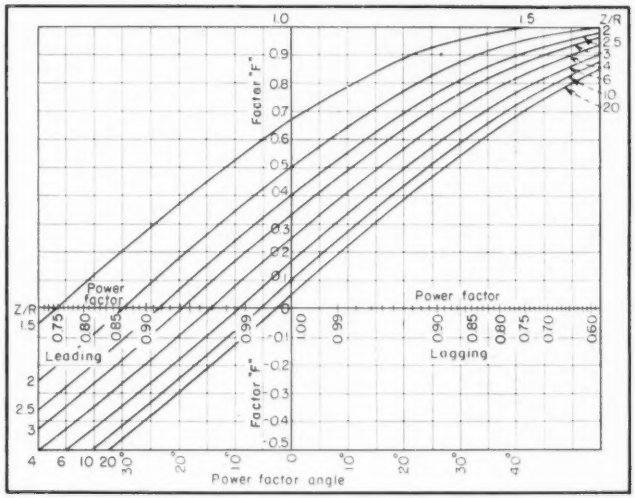
ACCOMPANYING GRAPH offers a rapid means of obtaining the correct transformer voltage drop over a wide range of transformer types and characteristics.

To make the curves suitable for the entire range from small distribution transformers to large power transformers, they have been prepared on the basis of ratios of impedance to resistance, that is Z/R from 1.5/1 to 20/1. The smaller ratios apply to small distribution transformers, while the higher ratios of 10/1 to 20/1 apply to larger transformers where the resistance is usually well under 1%.

Transformer impedance in percent is usually stamped on the nameplate or is available in transformer records. Resistance, available only on test reports, must frequently be assumed. If this assumption is made on a reasonable basis, taking into account the size of the transformer, the accuracy of the voltage drop calculation is not seriously affected. To assist in estimating resistance values, a table of typical values for various sizes and voltage ratings of transformers is included below.

Typical Values of % R in Transformers

1-Ph kva	Voltage Class				
	2.3 kv	13 kv	33 kv	44 kv	66 kv
5	1.9				
10	1.7				
25	1.5	1.6			
50	1.3	1.4	1.5		
100	1.2	1.2	1.4	1.4	1.4
250	1.0	1.0	1.1	1.1	1.1
500	0.9	0.9	0.9	0.9	1.0
1,000	0.8	0.7	0.8	0.8	0.8
1,500	...	0.7	0.7	0.7	0.7
2,000	...	0.6	0.6	0.6	0.6
3,333	...	0.5	0.5	0.6	0.6
5,000	...	0.5	0.5	0.5	0.5
10,000	...	0.5	0.5	0.5	0.5



Instructions for Use of Curves

To use the curves find the factor "F" from the particular Z/R curve at the correct load power factor. This factor "F" is then multiplied by the percent impedance of the transformer to obtain full-load voltage drop.

At any other load, the voltage drop will be in direct proportion to the load. For example, at 50% load the full-load voltage drop obtained from the curves will be multiplied by 0.5.

EXAMPLE

Assume the following transformer and load conditions:

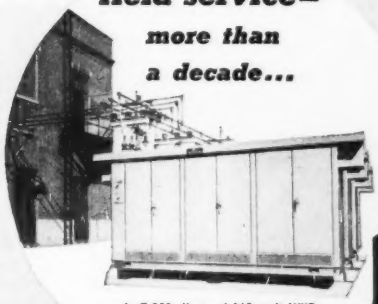
Three 1-ph, 500-kva transformers, primary 33,000 v
Transformer impedance, 5.4%
Transformer resistance (from Table), 0.9%
Ratio Z/R = 5.4/0.9 = 6.0
Power Factor of load, 0.82 lagging

Factor "F" obtained from the Z/R = 6.0 curve at 0.82 lagging power factor is 0.7. Multiplying this factor by the transformer impedance of 5.4%, a full-load voltage drop of 3.8% is obtained. If the transformer loading is 750 kva, or 50% of rating, the actual voltage drop will be 0.5 x 3.8 = 1.9%.

While transformer loads are usually at a lagging power factor, the use of synchronous condensers or capacitors may in some cases produce a net load at leading power factor in the transformer. In such cases, the factor "F" may be minus, as shown on the graph, indicating that a rise in voltage instead of a drop must be taken into account.

Another advantage of this method is the ability to see at a glance the effect of variation in % R and power factor. If either or both of these quantities must be estimated over a possible range, the resulting variation in voltage drop can be readily seen by inspection of the curves.

field service—
more than
a decade...



A 7,920 Kvar; 4,160 volt WYE, outdoor station-type C-D installation totalling 47,520 Kvar.

CORNELL-DUBILIER CAPACITORS FOR POWER-FACTOR IMPROVEMENT

What goes into a C-D power-factor capacitor? The finest components and construction, of course . . . *plus* the "fourth dimensional" quality you can't see: the C-D "know-how" that comes from years of experience in building capacitors for power-factor improvement. That's why C-D installations remain in service for *years*—with little or no maintenance. And that's why leading utility engineers specify C-D. Consult your local C-D field engineer, or write for technical data to Cornell-Dubilier Electric Corporation, Dept. D129, South Plainfield, New Jersey. Other plants in New Bedford, Worcester, and Brookline, Mass.; Indianapolis, Ind.; Providence, R. I. and Cleveland, Ohio.

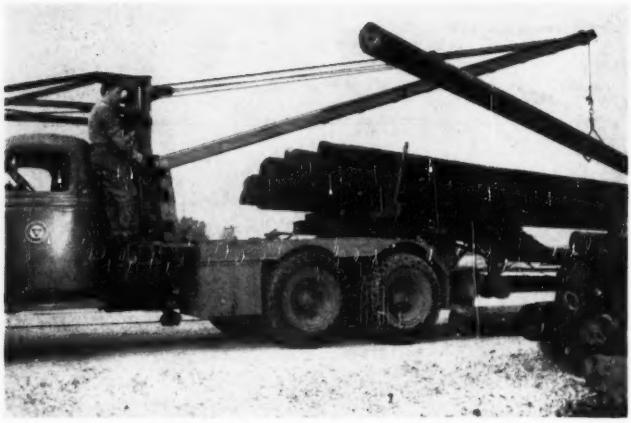
Follow the leaders

Demand dependable C-D Capacitors—built by capacitor specialists.

1910 1949
Reg. U. S. Pat. Off.

C-D Best by Field Test!

CORNELL-DUBILIER WORLD'S LARGEST MANUFACTURER OF CAPACITORS



POLE-HANDLING EFFICIENCY is increased more than 50% by tractor-trailer-crane

Tractor-Trailer-Crane Simplifies Pole Handling

L. J. RENAS
Supervisor Overhead Line Dept
and
S. MORITZ
Asst Supervisor Overhead Line Dept
The Dayton Power and Light Co

USING a tractor, trailer and crane combined as one unit, crews of The Dayton Power and Light Co are able to handle poles safer and faster. In the field this combination unit is 50% more efficient than other conventional means of loading and unloading poles. Men with little pole-handling experience can operate this unit with great ease and safety.

In the pole yard, when the pole yard crane is tied up or out of service, the combination unit loads other pole-handling units not equipped with the crane installation.

To permit handling of various sizes of poles, the tractor-trailer-crane unit is equipped with a telescope type stiff leg which extends to 7, 14 and 21 ft. The stiff leg is guided transversely and longitudinally by ⅝-in. steel cable driven through a power take-off from the tractor's prime mover. Load is handled by steel blocks and ⅝-in. steel cable.

Meter Test-kit Practice

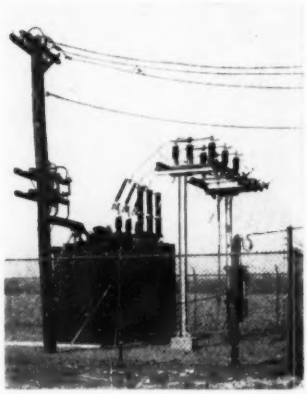
DATA from 26 operating utilities have been compiled by the Meter and Service Committee of Edison Electric Institute to reveal the weight and bulk of equipment carried by meter testers. Twenty have combined testers' equipment into one or two units for convenient carrying. Twelve use double-unit kits and eight use a single carrying-case. Dimensions of the latter vary from 14 x 6¾ x 10½ in. to 19 x 10 x 12 in. and for partial combination cases vary from 12 x 7½ x 10¾ in. to 17 x 17 x 10 in.

Reported weights of complete test outfits range from 28 to 40 lb for the 15-amp, 24 to 48 lb for the 25-amp and 33 to 60 lb for the 50-amp capacity sets. Seventeen of the companies use phantom-loading devices exclusively in the field testing of all sizes and classes of meters. Two utilities report the use of resistance loads only. Seven use either or both types of loading—the resistance load primarily for the lower-capacity single-phase meters.

The committee concluded that the spread in values justified exercise of ingenuity by manfacturers to develop light-weight testing equipment for field meter testers.

Feature Structure Unit Substation Installations

STRUCTURAL STEEL for mounting high tension bus and equipment has been designed by an eastern utility so that a simple termination feeding a unit substation can be accommodated. By adding standard steel members the unit structure can be expanded to a full bay that would be suitable for a large substation.



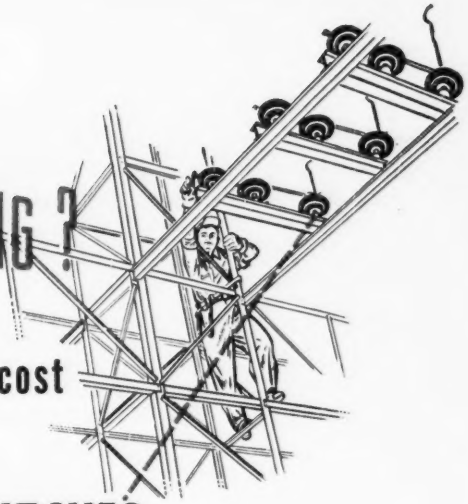
BASIC SUBSTATION structure comprises unit steel assembly and unit substation

The elementary structure, designated assembly "A", is a box frame mounted on two columns, all of which are made of 6-in. H-beams.

Cross members of the assembly mount the disconnect switches and dead end the primary lines. The steel parts can be stocked and are assembled by bolting. If necessary the structure can be disassembled and reused. Concrete footings will be the only item unsalvageable.

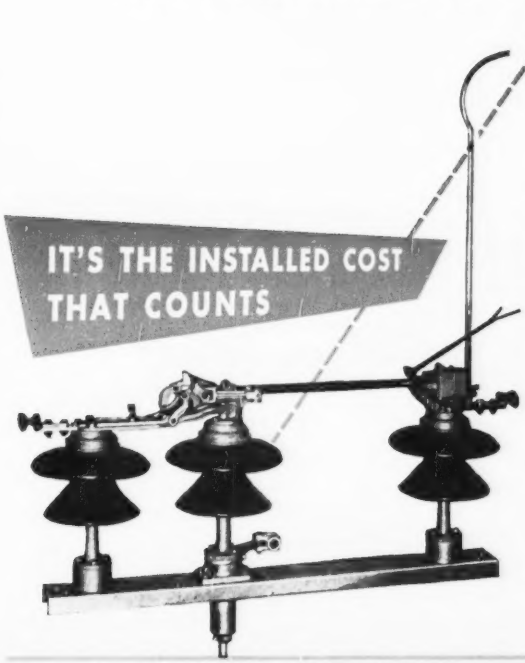
By the unit structure type of installation, savings are cumulative for design, drafting, stocking, supervision, erection time, expansion of the substation and finally salvage. This is in comparison to previous steel structures which had special design for each individual substation.

WHAT IS HE DOING?



Reducing switch installation cost 20 to 40% by installing

HI-VOLTAGE SWITCHES



HERE'S WHY... Every operating disconnect switch carries an expense in addition to its purchase price. From crate to operating position represents man hours and dollars.

It will pay you to examine your switch installation costs. Compute, as we did, the cost of field cutting and drilling . . . the cost of parts identification . . . the cost of field fitting . . . the cost of final adjustment. Add them up. This is the saving that Hi-Voltage Switches offer.

The Hi-Voltage Switch Operating Mechanism is pre-machined and pre-fitted at the factory. All parts are positively identified . . . keyed to easy-to-follow installation data. Every Hi-Voltage Switch is completely assembled and tested before shipment. This is the work we save your construction crew.

Specify Hi-Voltage and gain the advantages of lower installation costs, more accurate installation, more certain operation. After all . . . it's the installed cost that counts.

HI-VOLTAGE EQUIPMENT COMPANY

4000 EAST 116TH STREET • CLEVELAND 5, OHIO

EVERSTICK ANCHORS...

First Choice for

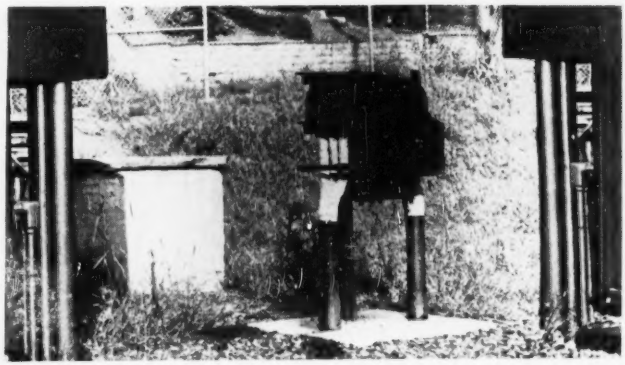
PERMANENCE
HOLDING POWER
LONG LIFE
SAFETY

They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install — made of tough rust-resistant malleable iron—their holding power "tops" all others. Available two-way, three-way, four-way and cone types. Write for facts.

Exclusive Everstick nut housing. Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO.
Manufacturer of "The Anchor of Merit"
FAIRFIELD, IOWA

Unit Subs, Tie Breaker Approximate Duplex Substation



THROWOVER SWITCH linking feeders of two unit substations is closed automatically by mechanical device to approximate performance of a duplex substation when one feeder fails

R. FENSTERMACHER
Philadelphia Electric Co
Norristown, Pa.

In certain built-up areas of the Philadelphia Electric Co system, where the load was being supplied by a single 1,500-kva unit substation, the added convenience and reliability of a duplex-type substation is being approximated in less space and without the added cost of replacing a unit substation with duplex equipment.

This was accomplished through the development of a mechanical device used with two single unit substations and a tie circuit breaker.

This device is connected to the operating shaft of a manually operated circuit breaker that links the feeders of the two unit substations. Automatic throwover is then obtained in essentially the same manner as in the standard duplex scheme. Power to close the tie circuit breaker is supplied when the stored up energy of a flat spiral spring connected to the operating shaft of the tie breaker.

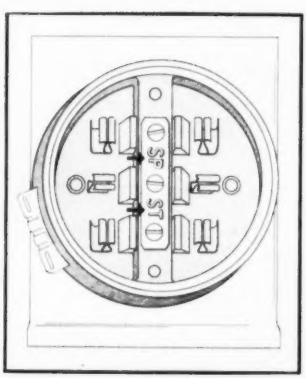
When voltage is restored to the interrupted transformer, following an automatic throw-over, the transfer back to normal operating conditions is performed manually.

Identification of Meter Socket Connections

RALPH A. MARSHALL
Haverhill (Mass.) Electric Co

Identification of the type of meter required for particular installations arises in connection with six-terminal sockets which may be wired for use with single-pole single-throw, or single-pole, double-throw switches. The six-terminal meter cover socket, as installed for electric water heating service, may not indicate the type of switch arrangement to be used in a two-rate meter to conform with the customer's wiring.

For the convenience of the meter installer and to eliminate the need for checking out the wiring of the water heater circuit a metal strip (like that



METAL STRIP with raised numbers on red background identifies type of switch arrangement to be used in a two-rate meter

A 5 WAY COMBINATION

HI-TENSION NEWS Junior

...in Deadend Clamps that Can't Be Matched!

★ No other high voltage hardware offers you this unique five-way combination found in O-B Cooline non-magnetic strain clamps.

1 **Adequate strength for the heaviest deadending.**

2 **Slip strength approximately 90 per cent of the cable's ultimate.**

3 **Fast, simple bolted attachment to cable. No cutting required, thus allowing continuous jumpers.**

4 **No magnetic heating of clamp, thus preventing low temperature annealing of cable and producing a power saving that will, in a few years, pay the clamp's total cost.**

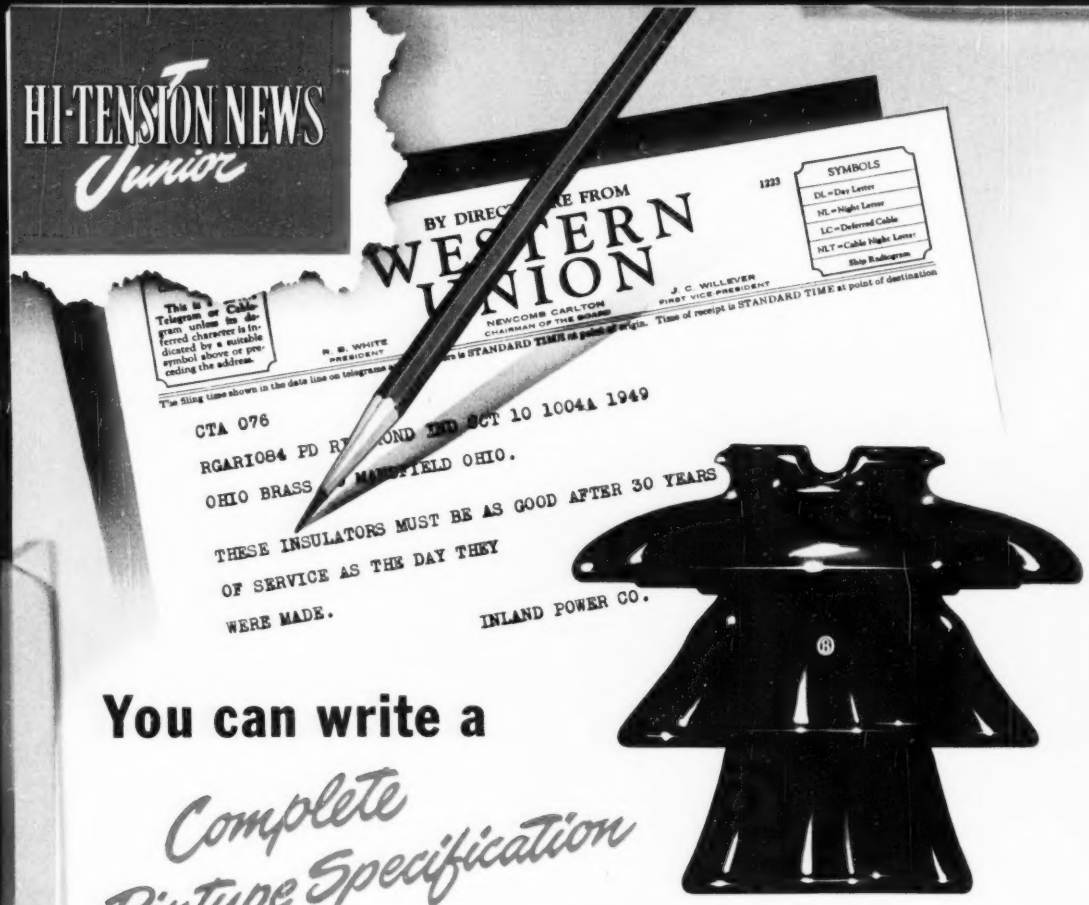
5 **No electrolytic action between clamp and cable because of like metals.**

This is the brief story of O-B's new Cooline nonmagnetic strain clamp. Talk to your O-B representative or contact us direct for more information. You can't get as much in any other deadend device today.

Ohio Brass

MANSFIELD, OHIO, U. S. A.

HI-TENSION NEWS
Junior



You can write a *Complete Pintype Specification* in a telegram!

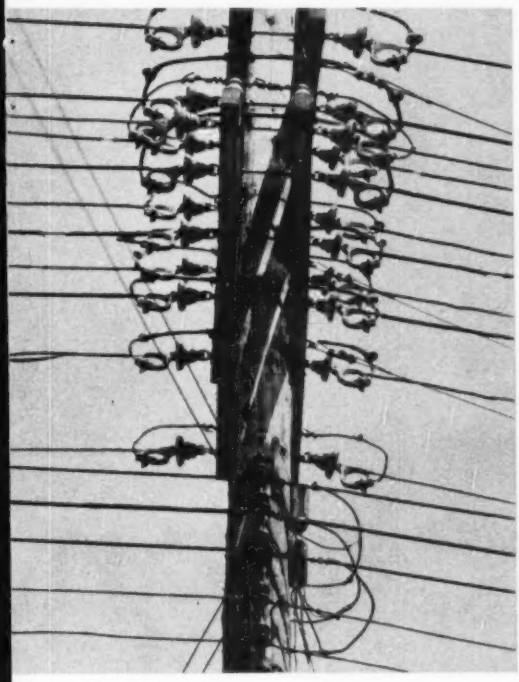
● We know one infallible way to specify a pintype insulator and be sure of getting what you want. Just put this on your order: "These insulators must be as good after 30 years of service as the day they were made." It would be a simple way to jump over all complications and get right down to the real nub of the problem. But because buying and selling must be completed more quickly, "book-length" tests are conducted to establish as surely as possible, ahead of time, what is really a very simple basic requirement.

As good as they are, these tests have one weakness. They apply to a new insulator, only. Yet your primary interest relates not to how good an insulator may be the first day, but *how good it will stay*! This is still a function of careful, skillful manufacture. It's not enough merely to know how to make a good pintype -- there must be a desire to apply what you know. And here is where O-B breaks away from the field.

Don't take our word for it. Investigate O-B pintypes on your own terms. You will find they have a "mysterious" habit of outlasting and outperforming others. But there is nothing mysterious about it. They are simply the product of the most capable company in the business, applying those capabilities to the limit.

You can actually write a 30-year specification covering pintype insulators -- 30 plus a lot more -- by merely putting "O-B" on your order.

Are You Going to Build Your Primary Deadends *Once or Twice* Within the Next Few Years?



● Figures recently published to the Electrical Industry show that, by the end of 1949, residential power load will have increased ten per cent *in a year's time*! From 1938 to 1948, this increase amounted to 82 per cent, and current information proves it hasn't leveled off. Some well-informed men talk in terms of a possible 500 per cent over today's demand in the clearly-predictable future.

What is the answer in terms of equipment? How can this power be delivered to residential users? Reconstruction of the entire urban distribution plant is one answer. The more practical and popular approach is higher voltage. Here, much of the existing equipment can be retained, but every deadend point on the system will require revision if built to older low voltage standards. This rebuilding must usually be done hot, in the crowded area of busy pole tops. It can be costly and somewhat hazardous.

There's a better way. Build all present deadends now – regardless of voltage – for the inevitable increase. Build just once instead of twice. It will easily save you half your ultimate deadending expense when local power demands require higher distribution voltages.

Experience has proved the most practical deadend to be made from a six-inch suspension unit and a suitable strain clamp. The O-B unit with a Universal Strain Clamp is being used by the hundreds of thousands for this service; continuously repeating orders testify to the complete satisfaction of this combination.

Build just once – and build the best – with this O-B deadend assembly.

Ohio Brass

MANSFIELD, OHIO, U. S. A.

To match power supply with public demand more quickly and economically, the single circuit unit substation fills an urgent modern need. This self-contained unit is easily moved between locations as the situation demands. While small in comparison with large central stations, these isolated installations demand even more attention to small details leading to maximum trouble-free operation, since they function with a minimum of human supervision – hence, the presence of O-B bushings on this Allis-Chalmers unit sub. Among its characteristics, pointed out by A-C, are . . . "Rating, 1500 kva. Voltage, 33,000-4160. Allis-Chalmers Oil-Sealed Inert Gas system for protecting oil, and 32 5/8 per cent step regulator mechanism. All components arranged for easy access for inspection and maintenance; consisting of a three-phase transformer, complete switchgear, tap changer, and necessary controls, plus . . ."

OB BUSHINGS

ONE OF THE FINEST COMPONENTS
OF ANY TRANSFORMER

2982

used in pole numbering) is made up and attached to the meter cover socket. This is stamped with an abbreviation for the switch arrangement (SP-ST; SP-DT; DP-ST; or other). To "flash" this information to the installer, this metal strip is first painted red. The raised letters are buffed off, so that they will show white against the red background. The strip is attached to the cover socket with screws which come with the latter. The same idea has also been used to indicate that a two-element network meter is required on a five-terminal cover socket, although the network connections are perhaps more easily identified by present equipment.

Aluminum Bands Badger Porcupines

PORCUPINES gnawed as much as 3 in. into pole bases before California Oregon Power Co adopted these 14-in. sheet aluminum bands

SHEET ALUMINUM BANDS are being used by California Oregon Power Co to prevent porcupine damage to a pole line through Modoc (Cal.) National Forest. Many poles had been chewed to a depth of 3 in.

The 14-in. bands are fastened to the pole with 2-in. aluminum roofing nails from a point at or immediately below the top of the treatment. This will protect the poles from porcupines both in summer and winter, when maximum average snow depth is approximately 2 ft.

MOSINEE

"More than Paper"

If you have a fabricating or processing problem involving paper . . . if you require definite technical characteristics and, above all, *dependable uniformity*, it may be worthwhile for you and MOSINEE technicians to get together. MOSINEE is not interested so much in terms of volume production as in our ability to render helpful service to manufacturers in the field of electronics and in the electrical goods industry. Our "paperologists" are at your service for consultation. Please write Dept. EW.

MOSINEE PAPER MILLS COMPANY • MOSINEE, WIS.

Essential Paper Manufacturers

LOAD BUILDING

Mid West Utility Revives Doorbell Ringing

BACK TO THE TRUCK for more fans from supervisor R. A. Lamar, at left in truck, come four salesmen, L. R. Reeds, I. W. Kendall, H. P. Wade and J. F. Armstrong

KANSAS CITY POWER & LIGHT CO in a postwar load building program has returned to the tried and proven doorbell ringing method—under close supervision and stimulation of salesmen through team-work within a group and competition between teams. Results, sales totaled:

4,300 window fans, May 1 to July 15, 1948
1,350 window fans, May 1 to June 6, 1949
10,000 clocks, July 15, 1948 to Oct 1, 1948 Telechron Kitchen clocks and alarm clocks
5,800 electric blankets, Oct 1, 1948 to Feb 28, 1949
1,100 fluorescent kitchen units, each with 4-30-w tubes from March 1 to May 1, 1949

Canvassing is carried on by six crews each consisting of a supervisor or crew manager and seven salesmen. A crew goes into a district and salesmen go down each side of the street ringing every doorbell, and the crew manager is right there on the job to reinforce the salesmen. Appliances are carried on the truck with the crew, and salesmen take the appliances with them when they go to the door, eliminating call backs and deliveries.

Evening canvassing is a unique part of this program. Started as a substitute for work during hot summer afternoons it has proved very effective. The schedule calls for canvassing from 8:30 AM to 12:00 noon and from 6:00 PM to 9:00 PM. Salesmen are free in the afternoons to go home and refresh themselves, take a rest or for any personal activity. Much of the time is spent developing leads and calling back in cases where they think a return will close a sale.

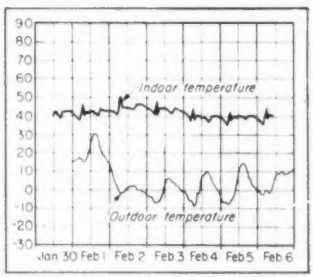
This program calls for going past every house in the city at 3- to 4-month intervals. Customers, both husbands and wives, have come to recognize the yellow KCP&L truck and to welcome the salesmen. Company executives believe that this is the only way to get volume sales of small appliances. They say, however, that success of the program hinges largely on having the right kind of supervisor over these crews, one who believes in the work and will work hard enough to make it successful.

Converted Milk Cooler Heats Milk House

MARVIN NABBEN
and
CHARLES WAGNER
Northern States Power Co
Minneapolis, Minn.

APPLICATION of the heat pump principle can convert the milk cooler, already available on many farms, to heat the milk house at low operating cost and low investment. In fact a well-insulated, 1,150-cu ft milkhouse can be maintained at 40 deg with a power consumption of ¾ of a kwhr per degree day. This compares with ¾ kwhr when using a fan type electric heater.

In converting a cooler the simple step required is the installation of a solenoid valve in the milk cooler incoming water line and controlling it



OPERATING the milk cooler as a heat pump, while cooling eight 10-gal cans of milk per day, keeps temperature inside milk house at or above 36 F with outdoor temperatures as low as —8 F. Milk cooled from 95 F to 40 F gives off heat equivalent to 2.3 kwhr for each 10-gal can of milk cooled

build more load with electric heat

G.E.'s new program on industrial electric heaters can help you!

Via the slidefilm, "Heat . . . Where You Want It," you can take your customers on a "seeing-is-believing tour" of dozens of plants where industrial electric heaters are doing a more efficient heating job in various applications on many kinds of machinery and equipment.

Then, to help them pin down the application of electric heat in their own jobs, there are five application bulletins—one on each of the major applications depicted below. In addition to the sound-slidefilm, each program kit contains 50 copies of each of these five application bulletins.

Available through your local G-E office, the complete kit (including slidefilm, record, and application bulletins) can be purchased for $15. If you haven't seen it, just clip the coupon to indicate when you'd like to have a showing. Or use it to order complete program kits for your own use.

HAVE YOU SEEN THESE OTHER MORE POWER TO AMERICA PROGRAMS?

Textile Mill Modernization
Electric Arc Welding
Oil Field Electrification
Industrial Power Distribution
Sewage Treatment
Resistance Welding
Materials Handling
Electric Transit

GENERAL ELECTRIC

Sect. B684-12
Apparatus Department
General Electric Co.
Schenectady 5, N. Y.

( ) We'd like a showing of your MPA program on Industrial Electric Heaters

( ) Send us ____ program kits @ $15.00 each.

Name .....

Company .....

Address .....

City ..... State .....

with a room thermostat. One precaution, however, is necessary to protect the milk in the cooler. That is to regulate the amount of incoming water so that the amount of heat to be removed does not exceed the capacity of the cooling unit.

In operation, when the room thermostat actuates and starts the flow of water, the ice bank melts and thereby starts the compressor. To obtain the best results, feed water should enter the tank as far removed from the refrigerator thermostat as possible.

New Water May Drop 10 Deg

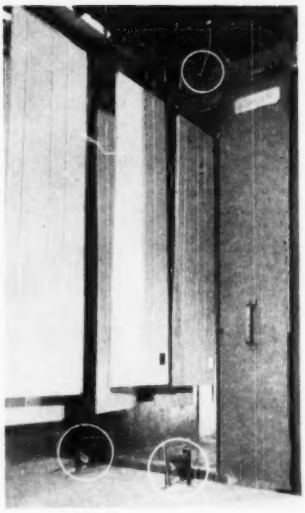
Since the water surrounding the ice bank may be about 35 deg, the new water may give off sufficient heat to drop 10 deg. A drop of that magnitude with a flow of about one gpm will result in a heat release of about 4,300 Btu per hr. A milk cooler refrigerator compressor of $\frac{3}{4}$ hp or larger has sufficient capacity to handle this output and would therefore constitute no danger to the milk temperature.

To arrive at the heat pump output, the Btu removed from the water is added to the Btu content of the motor power input. Assuming the performance co-efficient of the milk cooler to be only 3 and assuming $\frac{3}{4}$ kwhr per degree-day for direct heating, the milk cooler could heat the same milk house for $\frac{1}{3}$ of $\frac{3}{4}$ kwhr or $\frac{1}{4}$ kwhr per degree-day. This consumption total includes the energy used in cooling the milk. Actually, the co-efficient of performance may be as high as 3.75 or more for parts of this job.

Water pumping costs may be from 20 to 30¢ per month, depending upon the depth of the well and the electric rate. A suitable solenoid valve can be obtained for about $10.00; and a thermostat for $12.50.

Maintaining a 40 deg room temperature is recommended since the cost of heating rises rapidly above that figure and since the dairyman is in the milk house for such short periods. To gain personal comfort while there, the heat pump can be augmented by infra-red bulbs. The latter gives instant comfort without raising the room temperature and increasing costs. For example, four, 250-w lamps are ample for installation in the utensil washing area.

Electric Eye Guards Enameling Oven



UNIQUE SAFETY FEATURE of the electric enameling ovens in the plant of the Lustron Corporation, producer of factory-made homes, at Columbus, Ohio, is a photocell device that assures that panels are properly hung on the conveyor. The device provides an outline to which each panel must conform; the conveyor stops when an improperly hung panel comes to the door of the oven. There are 2 of these ovens in the Lustron plant, each 130 ft long, 2,500 kw, and, working together, they can process 58,000 lb of porcelain-coated panels per hour. Accurate and flexible temperature control was obtained by grouping heating elements into 32 separately controlled zones.

Wot, No Can Opener?

LOOKING at American electric appliances, visitors from England to these shores have more than once remarked that housewives of the tight little island would not be bothered with such gadgets. In the accompanying pictures of two super-gadgets is evidence that the Britishers have abandoned that attitude if, truly, they ever had it. These machines are the solutions of two inventors to the problem of applying electric power to kitchen and other household tasks—scouring pots and pans, grinding meat, slicing and shredding vegetables, juicing oranges, beating eggs, stirring batter, cutting bread and even rejuvenating the housewife with a message.

(British Information Services)

ELECTRIC "HOUSEMAIDS" to lighten kitchen labor are appearing on the British scene

NICHROME*
MARCHES IN THE BIG PARADE

. . . marches with American engineering and craftsmanship, beneath banners blazoned with brand names famous throughout the world.

To the electrical manufacturer who is not already using Nichrome, this is a fact for serious consideration. Significant as it is that "a man may be judged by the company he chooses", it is doubly significant that Nichrome may be judged by the companies who choose it!

Nichrome is manufactured only by

Driver-Harris Company

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

Manufactured and sold in Canada by
The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

50TH YEAR — SPECIAL PURPOSE ALLOYS SINCE 1890 — D/H — TRADE MARK REG. U.S. PAT. OFF. — 1899-1949

Nichrome IS THE VERY HEART OF GOOD ELECTRICAL APPLIANCES

Most of the insignia above are Reg. T. M. of their companies.

*T.M. Reg. U.S. Pat. Off.

NEW EQUIPMENT

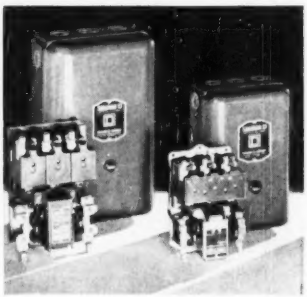
1-Phase Watthour Meter

ANOTHER MANUFACTURER has entered the watthour meter field with a new socket type meter for house service that employs unit construction of all four major assemblies: base, electromagnet, damping system and register. This construction permits the meter to be kept in step with load growth since current and potential coils can be replaced with coils of other ratings.

The Type S-3 meter, which is available in 2- or 3-wire, single-phase, 5- or 15-amp rating for 120- or 240-v service may be had with either clock type or cyclometer registers.

Other features of the meter include: *Base*—One-piece crack-, warp-, and break-proof steel with Melamine insulation and 100% wool felt gasketing; *Electro-magnet*—Overload compensation to 400% of rated load is provided, layer-wound, vacuum-impregnated potential coil, separable current and potential coil laminations of electro-magnet are replaceable—thus they facilitate current and potential coil changes; *Damping System*—One-piece back plate supports damping system, aluminum-alloy disk supported on selected alloy steel ball bearing between saphire jewels, magnets silver-plated to provide shielding against lightning surges, light and full load adjustments from front of meter; *Register*—Dial or cyclometer-type registers are interchangeable and feature large dials, numerals and pointers; *Cover*—Standard cover has clear flint glass viewing surface, sealing ring compresses resilient, non-corroding gasket of Corprene against meter base; *Finishes*—Zinc, cadmium, albaloy and lacquer finishes used on structural parts of meter insure reliable operation under severe service conditions.

Roller-Smith, Bethlehem, Pa.



cessible without removing wiring, and the coil is removable with a screw driver. Complete details are in Bulletin 8536.

Square D Co, Industrial Controller Div, 4041 N. Richards St, Milwaukee 12, Wis.

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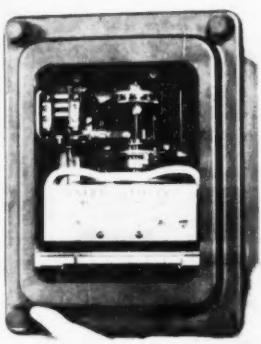
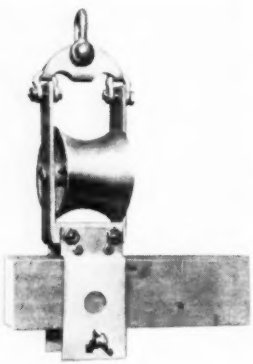


Overcurrent Relay

AN OVERCURRENT RELAY, Type IAC-77, is designed to possess an extremely inverse time characteristic curve approximating those of power fuses and distribution cutouts. This relay is said to provide adequate fault protection for most distribution feeders and to pick up loads of automatic devices when they have been brought back onto the line after outages of sufficient duration.

Reason for the characteristic being made even more inverse than that of the present "very inverse" relays is that an inrush current, after an extended outage, frequently exceeds the minimum value of short circuit current at



Stringing Dollys

A STRINGING DOLLY that can be used for aerial cable or large power conductors can be mounted on top of crossarms in either a vertical or horizontal position. It can also be suspended below arm or other fastening, chain mounted direct to pole for large angles, or attached to pole on combination support bracket by chain tightener in an open-yoke position or flexibly suspended. Crossarm hangers have saw-tooth clamping to fasten to 3½ x 4½ in., 3¾ x 4¾ in., or 4 x 5 in. crossarms.

Pulleys are cast aluminum, with oilite bronze bearings set on steel sleeved pins. Dollys are available with groove openings 2½, 4½, or 5½ in. wide and pulley diameters at bottom of groove of 4½ or 10½ in.

Distribution & High Line Specialties Co, 2100 Del Norte St, St. Louis 17, Mo.

•

Starters and Contactors

A LINE of a-c magnetic starters has been designed with standardized wiring and mounting dimensions to simplify engineering, installation, and maintenance of machine controls.

Sizes 0 through 3 include straight-line guided motion of armature and movable contact assembly. Double break, silver-to-silver contacts are ac-

Have you seen

THE NEW

Street Lighting Brackets

The Hubbard Round Brace Type is a graceful, one piece Bracket in which the ¾-inch diameter brace is welded to the bracket at its contact points, giving the arm unusually high strength. One piece design permits fast, efficient mounting.

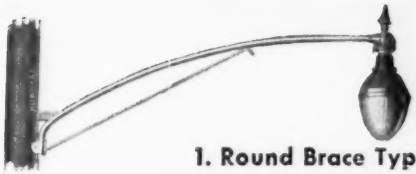
The Hubbard Tie Rod Type is a strong, rigidly supported Mast Arm made from 1¼-inch nominal Diameter Pipe. ⅜-inch diameter tie rods allow for adjustment of the arm as well as adding strength to the assembly.

Hubbard Truss Type Mast Arms are formed by welding heavy angle steel and truss plates to 1¼-inch pipe. Tie rods increase the assembly strength and permit adjustments to be made after mounting.

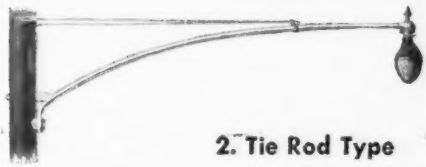
The Hubbard Municipal Type Bracket is our most popular design for Urban Areas. It is used for externally wired systems on both wood and steel poles. Municipal Brackets are easily installed by one man. The clean, modern appearance of the Municipal Type is always pleasing.

The Hubbard Universal Type Bracket is the outstanding development in the manufacture of street lighting brackets in recent years. May be used for external or internal wiring on steel poles and for external wiring on wood poles. No scroll or brace is needed because of the great strength of this design.

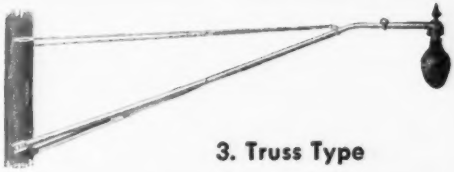
Hubbard Parkway Brackets are designed for internally wired steel poles. They may be mounted singly, as shown, or back to back. Brackets of this type are well adapted to modern roadway design. The rugged simplicity of their assembly reduces maintenance to a minimum.



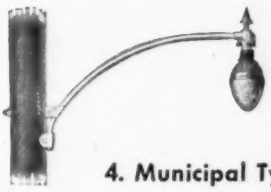
1. Round Brace Type



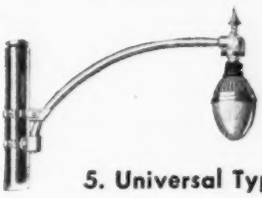
2. Tie Rod Type



3. Truss Type



4. Municipal Type



5. Universal Type

6. Parkway Type

All welded construction throughout
Requires small pole mounting space
Meet all EEI-NEMA lighting specifications
"Keyhole," basic feature of pole attachment, permits installation by one man
Simplicity of design means low cost
Permanently aligned at factory
These and other outstanding improvements found only in Hubbard Brackets and Mast Arms, covered by patents pending

HUBBARD AND COMPANY

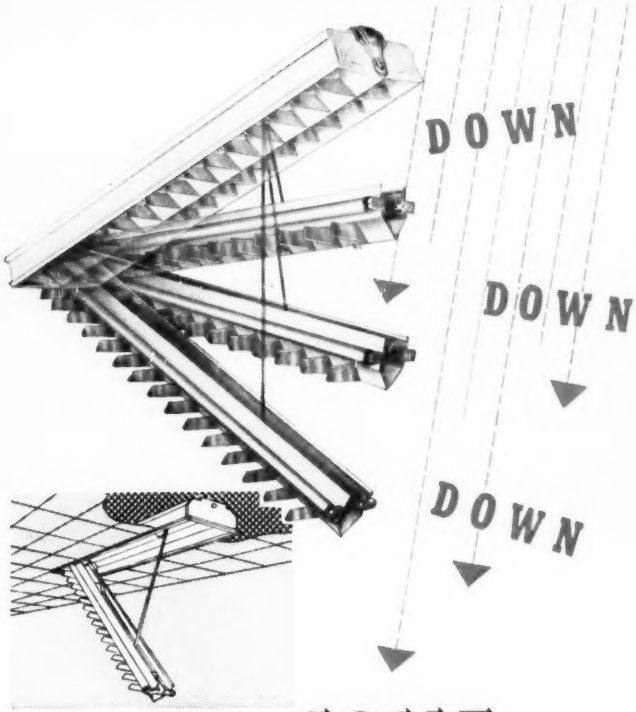
PITTSBURGH
CHICAGO

OAKLAND
CALIFORNIA

HUBBARD and Company, Advertising Dept. SL-2
6301 Butler Street, Pittsburgh 1, Pa.

Please send, to my attention, literature describing in detail the new line of Hubbard Street Lighting Brackets.

Name .....
Company .....
Title .....
City ..... State .....



COME
maintenance costs

...on the "JACKNIFE" HINGE TROFFER* and GUTHLITE*!

With one twist of the ingenious maintenance rod, *everything*—lamps starters, reflectors, louvres, ballast and wiring—swings down to your fingertips for *ladderless* servicing—and pulls maintenance costs right down with them! This exclusive feature of the "Jacknife" Troffer and Guthlite makes upkeep far faster, easier, safer—and up to 80% more economical.

You'll find complete details of this and many other Guth profit-building advancements in our handy new Pocket Catalog 46A-H. Ask for it *today*—from

Guth LIGHTING

THE EDWIN F. GUTH COMPANY / ST. LOUIS 3, MISSOURI

Leaders in Lighting Since 1902

*® 873

which the feeder relays should be set to clear.

The relay also has the usual features of time dial, tapped coil, single contact with target-seal-in device, and provision for instantaneous attachment. Further information is in Bulletin GEA-5443.

General Electric Co Apparatus Dept, Schenectady 5, N. Y.

•

Vertical-Mounted Motor

FEATURES of the Speed-Trol vertical-mounted motor include a speed indicator said to allow speed adjustment through either the fingertip control on the motor or through mechanical, electrical, or lever-type controls. Power unit is the Klosd-Tite motor, built integrally with pulleys, shafts, and belts. Motor incorporates labyrinth seals, dual cooling system, and die-cast herringbone rotor.

Single and double reduction types

MORE NEW EQUIPMENT

Just Received

Appearing Next Issue

AIR INTERRUPTER SWITCHES
Utilize two-part interrupter unit of dry type

AUTOTRANSFORMER STARTER
Air-break contacts readily convertible to oil-immersed

WATTHOUR METERS
Adjustable without removing from switchboard panel

DISCONNECTING SWITCH
Braidless switches have simplified operating mechanism

MULTIPLE PURPOSE CONNECTOR
Three sizes accommodate wire from No. 1 to 1,000 Mcm

REGULATOR BY-PASS SWITCH
Reportedly accomplishes functions of four disconnects

You can do a lot

with a little GOLD SEAL TAPE

It's the favorite of linemen and electricians year in and year out because there's no *waste*. Gold Seal goes further. This extra tape value in each roll is like a gift. But that's not all you get in Gold Seal. . . .

Laboratory-controlled production assures plenty of "tack" in the friction compound. And you can't beat this tape for high dielectric strength. It tears easily, quickly . . . will not dry out, peel or ravel. Yet it consistently gives a tighter, longer-lasting bond.

Hot or cold, rain or shine, here's a tape you can count on to produce better taped joints, and more joints per roll. Try Gold Seal. Conveniently packaged in single rolls and ten-roll containers. Each roll is cellophane wrapped — *factory-fresh*. Jenkins Bros. (Rubber Division), 80 White St., New York 13, N. Y.

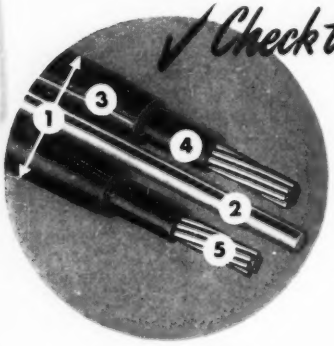
Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet both ASTM and Federal Specifications.

JENKINS Gold Seal Tape

FRICTION and RUBBER TAPES

MADE BY JENKINS BROS. . . . MAKERS OF FAMOUS JENKINS VALVES

Collyer Neutral–Supported Service Cable is "tops" with both purchasing and operating departments of utility companies. Lower in first cost than Types SE or SD, this compact cable is economical to install and maintenance is practically eliminated. Only minor changes are necessary in this simply designed cable to adapt it for use on commercial services, multiple street-lighting or secondary circuits. The weight of the cable is supported by a bare, hard drawn copper messenger which also serves as the neutral conductor, leaving the power conductors free of tension ready for easy tapping and splicing. The hard drawn copper messenger combines ample strength with excellent conductivity. This messenger may be neoprene covered, if necessary, to meet local requirements. Conductors are jacketed with neoprene, firmly bonded to Performance Grade rubber insulation of high dielectric strength. Collyer Neutral-Supported Service Cable gives extra protection against abrasion, flame, moisture, and sunlight—it is built for lifetime service.



✓ Check these features :

1 Compact cross-section
2 Bare copper neutral (messenger)
3 Tough neoprene outer sheath
4 Performance Grade rubber insulation
5 Easy-to-get-at conductors

Write today for complete information and samples of Collyer Neutral-Supported Service Cable.

Collyer INSULATED WIRE CO.
245 ROOSEVELT AVE., PAWTUCKET, R. I.

are available from ½ to 7½ hp with speed variations of 2:1, 3:1 or 4:1; sizes to 25 hp are available with 2:1 variation only. Illustrated is Style C, face mounted with reduction gears.

Sterling Electric Motors, Inc, 5401 Anaheim-Telegraph Rd, Los Angeles 22, Cal.

•

Drop Wire Hook

A NEW DROP WIRE HOOK for fastening the strand clamp in service drop wire installations has been developed. Main feature of the design is the elimination of slipping off and cutting of the flexible bail wire. Made of malleable iron, hot galvanized, it can be mounted on any type of masonry or frame wall, pole or crossarm.

T. J. Cope, Inc, 711 S. 50th St, Philadelphia 43, Pa.

•

Plastic Nameplates

NAMEPLATES, markers, instruction panels, and directions are available with specified lettering in rectangular, circular, or irregular outline. Letters and numbers are engraved through the surface of a laminated plastic sheet ⅛ or ☆ in. thick. Height of the letters can be from ⅛ to 2½ in. on surface colors of black, red, or white.

The plastic can be wiped clean with a damp cloth and is claimed to be weatherproof, fume proof, and impervious to changes in temperature.

Industrial Name Plate Service, P. O. Box 5005A, Houston 12, Tex.

•

Class B Insulation

QUINORGO No. 4000 has been developed for use as a Class B (hot spot temperatures to 130 C) electrical insulating carrier sheet to be combined with other insulating sheets or films.

This insulation is basically the same as Quinorgo No. 3000, the difference being in penetration characteristics. No. 4000 contains 3% or less resin which is reported to reduce absorption and penetration. Shellacs or other adhesive mixtures, spread on one side

It's This "One-Piece" Jaw

That Does the Trick in FARGO Automatic Line Splices

And Here's Why:

1 Precision machining of the "one-piece" jaw from solid bar stock assures *permanent alignment* of jaw segments, which prevents individual strands of the conductor from getting out of place.

2 Because of "one-piece" construction, jaw segments flair out slightly as the wire is inserted to give an excellent initial grip on the wire.

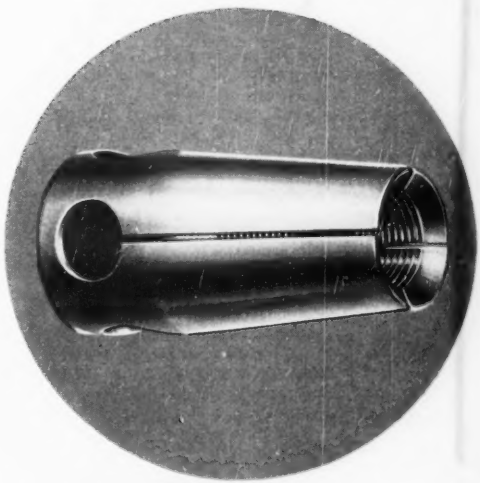
3 The entire jaw assembly and conductor move forward as a unit when tension is applied to complete the grip—so it can't let go!

4 The "one-piece" jaw permits a liberal safety zone to be machined into the back of the jaw to accommodate burred ends of the conductor.

5 The "one-piece" jaw is made of durable "Duronze," with sharply machined teeth that give a strong, corrosion-resisting bite on the conductor.

•

Fargo Automatic Line Splices . . . Reducing Splices . . . and Dead Ends are available in sizes from #8 solid to 500MCM. Your Line Material sales representative will be glad to give you complete details on these and other Fargo Devices.



FARGO

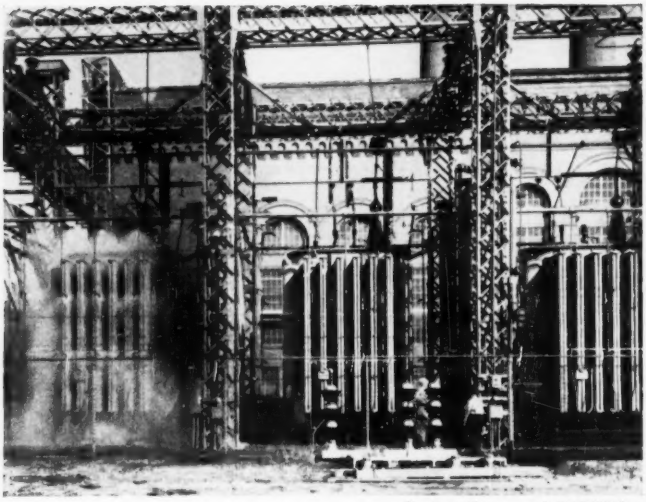
Manufactured by

FARGO MFG. COMPANY, INC.
Poughkeepsie, N.Y.

Distributed by

LINE MATERIAL COMPANY
Milwaukee, Wisconsin

LM



Southern utility company's 15,000 KVA transformers under "Automatic" FIRE-FOG blanket of protection

Detect FIRE Fast! Extinguish FIRE Instantly!

WITH "Automatic" FIRE-FOG

IT'S ELECTRICALLY SAFE AND FIRE SAFE

You don't have to be an economist to recognize the serious financial losses involved in fire incurred power failures in transformers and associated electrical equipment. They're losses that go far beyond the destruction visible to the human eye. Industrial out-of-service time for example, often far exceeds actual property damage, yet seldom is it evidenced in fire reports. . . . They're unnecessary losses too, for modern *Automatic* FIRE-FOG is now available for the protection of many types of electrical equipment. Detection of fire is automatic . . . FIRE-FOG operation instantaneous. From strategically located nozzles, a barrage of fine water spray is directed at the heart of the blaze. Flames are beaten down . . . the fire area cooled, and seconds later, extinguishment is complete with damage confined only to the point of fire origin. Power service may be readily restored and *Automatic* FIRE-FOG although composed of water, is electrically safe and carries the approval of all leading insurance authorities.

Industry's unremitting demands have past proved the safe, dependable and economical protection provided by *Automatic* FIRE-FOG. What it can do for you can best be told by one of our representatives who will gladly assist in your fire protection planning and furnish surveys and estimates without cost or obligation.

Automatic FIRE-FOG
• IT BLANKETS • IT ISOLATES • IT QUENCHES •

. . . a famous member of the *Automatic Sprinkler* Family . . . provides basic fire protection for process equipment and storage in the chemical and petroleum industries. On-the-spot protection for quench tanks, dryers, explosive hazards, conveyor openings, air filters, oil filled electrical equipment and other units vital to production line operations.

"AUTOMATIC" SPRINKLER CORP. OF AMERICA
YOUNGSTOWN 1, OHIO

Automatic Sprinkler
FIRST IN FIRE PROTECTION
DEVELOPMENT . ENGINEERING MANUFACTURE . INSTALLATION
OFFICES IN PRINCIPAL CITIES OF NORTH AND SOUTH AMERICA

of No. 4000 sheets, leave the opposite surface ready for absorption of treating varnishes used in the further processing of equipment. Other characteristics are listed in the table.

Nominal Thickness, in.	Machine Direction Tensile Strength, lb per in. of width	Dielectric Minimum, per mil
0.005	15	300
0.007	19	300
0.010	21	250
0.015	28	200

Continuous rolls in widths up to 3 ft, or sheets cut to size, are available.

Johns-Manville, 22 E. 40th St, New York 16, N. Y.

•

Heating Wire Set

THERMWIRE heating wire sets will prevent ice and snow formation on shipping and receiving platforms, driveways, walks and signs, the manufacturer reports. Other suggested uses include de-icing cars and equipment and warming motors for winter starting. The flexible insulated resistance wire can be buried directly in soil or concrete, immersed in liquids, or exposed to weather.

In the standard heating unit, an 80-ft loop of Thermwire is welded at each end to a 10-ft color coded, plastic insulated, flexible copper connecting wire attached to a male plug—making a circuit loop totaling 100 ft.

A miniature pre-set weatherproofed thermostat is connected in the center of the loop to insure correct temperature. Unit consumes about 400 w at 110-115 v a-c.

Thermwire Co, Morris Plains, N. J.

•

Portable Pyrometer

SURFACE and sub-surface temperatures can be determined with a self-contained, portable pyrometer. The instrument is said to be adaptable to a wide variety of measurement problems by

New! GLAZON TRADE MARK "TRIEX"

PREPARES FOR STRIPPING 5 times Faster!

HERE'S WHY:

The Present Way

You have to split the outer covering and trim it off. Then rip off the filler if it doesn't come away clean. Spread the wires apart and u-n-w-i-n-d the kraft paper wrap from one, *then* u-n-w-i-n-d the paper wrap from the other.

The New TRIEX Way

Just split the "Glazon" covering—tear it off—zip! The wires are ready to strip! That's all!

PLUS! EXTRA THICK INSULATION!

Not just the 2/64th rubber thickness found in ordinary cable . . . nor even a generous 3/64ths . . . but 4/64ths inch thickness of Type R rubber surrounds each conductor—even on sizes 14 and 12! You can see for yourself what this means in terms of extra protection . . . extra safety—and at no extra cost!

PLUS! EXCLUSIVE "GLAZON" COVERING!

TRIEX is the only non-metallic sheathed cable with this tougher, stronger, longer-lasting outer covering. Based on an inorganic substance derived from glass—which cannot burn, rot, or corrode; which is not affected by water, moisture, acid fumes, fungus or sunlight—"Glazon" achieves new highs in resistance to fire, moisture, oil, rodents and other elements that attack ordinary coverings. Clean and easy to handle—new finish uses no mica—it's slick!

Now you can prepare TRIEX Non-Metallic Sheathed Cable for stripping *five times as fast* — thanks to this new Triangle development!

Compare the *ordinary* way of preparing *present* types of non-metallic sheathed cable with the *faster* way, the *easier* way, the *simpler* way, of preparing Triangle's *new* TRIEX! See for yourself how you can save time and money at every switch box, outlet box, junction box . . . wherever connections are made!

Available in sizes 14/2, 14/3, 12/2 and 12/3 . . . solid or stranded . . . with or without ground wire. For 600 volt service.

If It's "Glazon" TRIEX It's Made by Triangle . . .
If It's Made by Triangle IT MUST BE RIGHT!

For samples and full information, contact your nearest Triangle distributor or representative, or write

TRIANGLE CONDUIT & CABLE CO., INC.

1900 JERSEY AVENUE • NEW BRUNSWICK, N. J.
PLANTS: NEW BRUNSWICK, N. J. • MOUNDSVILLE, WEST VA.

ARTERIES FOR ELECTRICAL SYSTEMS — INCORPORATED

IT MUST BE RIGHT!

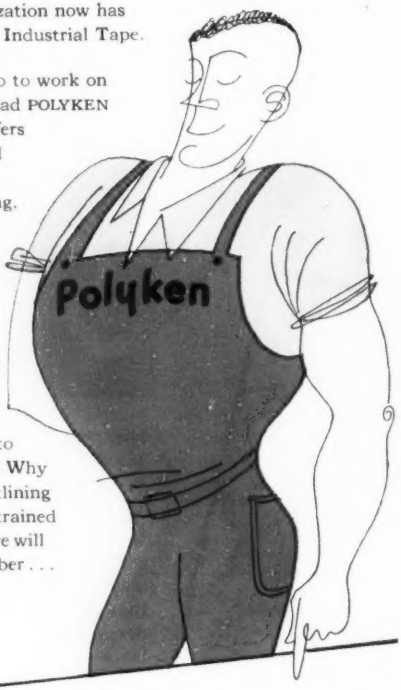
BUILDING WIRE • BARE WIRE • ARMORED CABLE • "GLAZON" TRIEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE, SERVICE DROP, VARNISHED CAMBRIC BRAIDED OR LEADED, TRIOPRENE TRENCH, POWER AND PARKWAY CABLES RIGID CONDUIT • ELECTRIC METALLIC THIN WALL CONDUIT • FLEXIBLE STEEL CONDUIT

Is Polyken® a part of your production future?

So many firms have cut costs, improved efficiency with Bauer & Black Industrial Tape that the expanded Bauer & Black Industrial Tape organization now has a new name: POLYKEN Industrial Tape.

POLYKEN is ready to go to work on *your* problem. The broad POLYKEN Industrial Tape line offers dozens of cloth-backed industrial adhesive tapes for bundling, tying, holding, surfacing, sealing, laminating . . . or you name it. And for special jobs, Bauer & Black research laboratories offer a *free* technical service.

Put fifty years of production experience to work on your problem! Why not write us today, outlining details? A technically trained POLYKEN representative will gladly call. And remember . . .



BAUER & BLACK Industrial Adhesive Tape
is now being sold under this new trade name:

Polyken® INDUSTRIAL TAPE

DEPARTMENT OF BAUER & BLACK
DIVISION OF THE KENDALL COMPANY
222 W. ADAMS ST., CHICAGO 6

reason of the selection of thermocouples offered. Instrument features a 4-in. direct-reading indicator mounted in a rubber cushioned housing.

Two series of models offer either a rigid extension arm (illustrated) or a 42-in. flexible arm suitable for use with any one or more of eight types of available thermocouples. Each series is obtainable in four temperature ranges from 0–400 F to 0–1,200 F, and thermocouples may be interchanged without adjustment or recalibration. A detailed description appears in Catalog No. 180.

The Pyrometer Instrument Co, Inc, Bergenfield, N. J.

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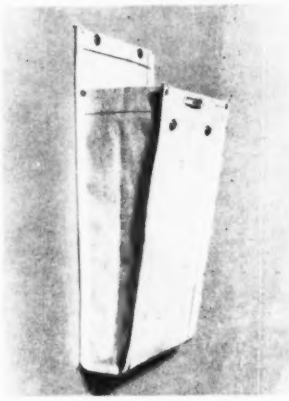


LINEMAN'S GLOVE BAG—A lineman's glove bag has been tapered to increase the opening of 3 in. at the mouth to a total of 6 in. Bag is woven of No. 6 waterproof duck and has two-way snap hook with D ring and snap-down flap. Further information is in Bulletin 317.

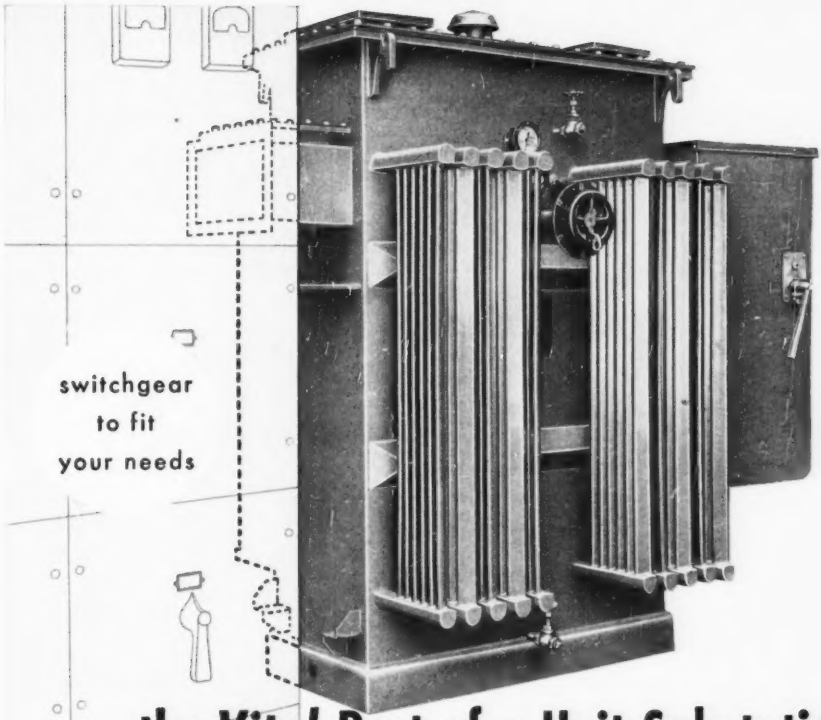
Davis Emergency Equipment Co. Inc, 108 Halleck St, Newark, N. J.

•

Welding Controls

TWO ELETRONIC control units for high-speed resistance welding have been produced without moving parts in power and control circuits except initiation and solenoid relays.

Basic control panels consists of a plug-in Rectox rectifier tube firing panel or a heat-control firing panel, respectively for non-synchronous or synchronous units. Also included



the *Vital* Part of a Unit Substation is the Transformer

• Wagner Unit Substation Transformers can be Throat Connected to any make of Switchgear...The transformer is the vital part—the fuel pump—of a load center distribution system. If the transformer fails, the entire system is dead, whereas only part of the distribution system may be affected by the failure of a switch or circuit breaker.

You can be sure of a dependable continuous flow of power from a Wagner transformer and you can be sure that it has been carefully designed to meet your distribution requirements.

Wagner unit substation transformers with incoming high voltage switch sections to meet your requirements, and, with proper throats on the secondary side for connection to any make of switch-gear, are available in the usual range of ratings up to 2000 kva. Our factory-trained sales engineers are well qualified to recommend the various combinations necessary to handle your unit substation requirements and will gladly give you immediate service.

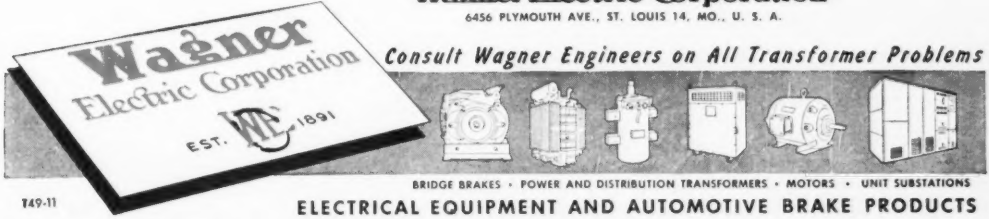
Wagner unit substation transformers are installed in numerous electric generating stations and in all kinds of industrial plants including synthetic rubber, petroleum, steel, chemical, aircraft, automotive, paper, and many others. The importance of the transformer in a unit substation justifies calling in the Wagner sales engineer to help solve all your load center problems.

Our free bulletins TU-13 and TU-56 describe the design and construction features that make Wagner liquid-filled and dry-type unit substation transformers outstanding.

Wagner Electric Corporation

6456 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.

Consult Wagner Engineers on All Transformer Problems



BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

T49-11

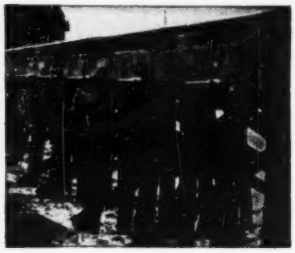
ELECTRICAL EQUIPMENT AND AUTOMOTIVE BRAKE PRODUCTS

KOPPERS CREOSOTE -to be sure!

DECKING 14 YEARS This car, with pressure-*creosoted* decking, was side-tracked for its first decking repairs after 14 uninterrupted years of service. Usual life of untreated car decking is about 5 years. Not only did pressure-*creosoting* cut maintenance costs; it prolonged the revenue-producing life of the car.

POLES 30 YEARS On the average, Pressure-*Creosoted* Poles have a life expectancy of more than 30 years. Pressure-*creosoting* offers *proved* performance and dependability.

PILES 30 YEARS Pressure-*Creosoted* Piles give unrivalled protection against decay and marine borers. Many *creosoted* marine piling installations are reported sound and serviceable after more than 30 years of use. Pressure-*creosoting* lowers maintenance costs.



BRIDGES 40 YEARS This is one of several pressure-*creosoted* timber bridges which is still in use after more than 40 years. The resistance of pressure-*creosoted* bridges to decay, year in and year out, assures uninterrupted service and low annual replacement costs.

TIES 25 YEARS Pressure-*creosoting* pays off to railroads. The long life of pressure-*creosoted* ties (25 years isn't unusual) has cut replacement costs $88,500,00 annually.

All Standard Specifications
For All Types of Wood Preservation

KOPPERS CREOSOTE

KOPPERS COMPANY, INC. • Pittsburgh 19, Pa.

among the basic controls is a sequence weld timer that controls squeeze time, weld time, hold time, and off time for single impulse spot welding.

Space is also provided for the addition of auxiliary control panels such as an a-c timer or d-c forge timer, wave-shape control, voltage compensator, initial-squeeze attachment, and interlocking relay attachment enabling the use of one control with two welding machines.

Westinghouse Electric Corp, P. O. Box 868, Pittsburgh 30, Pa.

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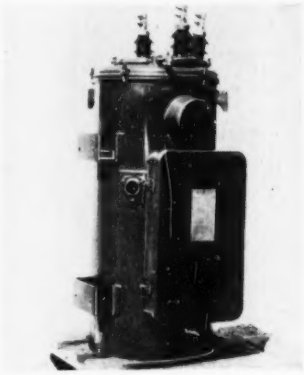

Voltage Regulator

THE NARROW band width of 8-step regulators is provided in the Type ML-8 step-type branch line voltage regulator. It supersedes Type ML-4, providing a total of 10% regulation in eight 1¼% steps.

Regulation in the following combinations is obtainable: 10% raise, 7½% raise to 2½% lower, 5% raise to 5% lower, 2½% lower, 2½% raise to 7½% lower or 10% lower. Unit is available in selected kva sizes in 2,500, 5,000, and 7,620-v ratings and corresponding Y-connected voltages.

Other features include an improved tap-changing switch, cover bushings with clamp-type terminals, and a "load-bonus" feature that permits increase in current carrying capacity up to 160% for the 5% raise to 5% lower connection. More information appears in Bulletin GEA-5417.

General Electric Co Apparatus Dept, Schenectady 5, N. Y.

•

Motor Speed Control

FRACTIONAL HORSEPOWER MOTORS can be controlled directly from the a-c line with Type 1701-A Variac speed control. Range of continuous speed variation is from rated speed down

SEND FOR THIS 32 PAGE MULTICLONE BOOKLET

HELPFUL-INFORMATIVE IT OUTLINES THEORIES AND BASIC PRINCIPLES OF CENTRIFUGAL DUST RECOVERY!

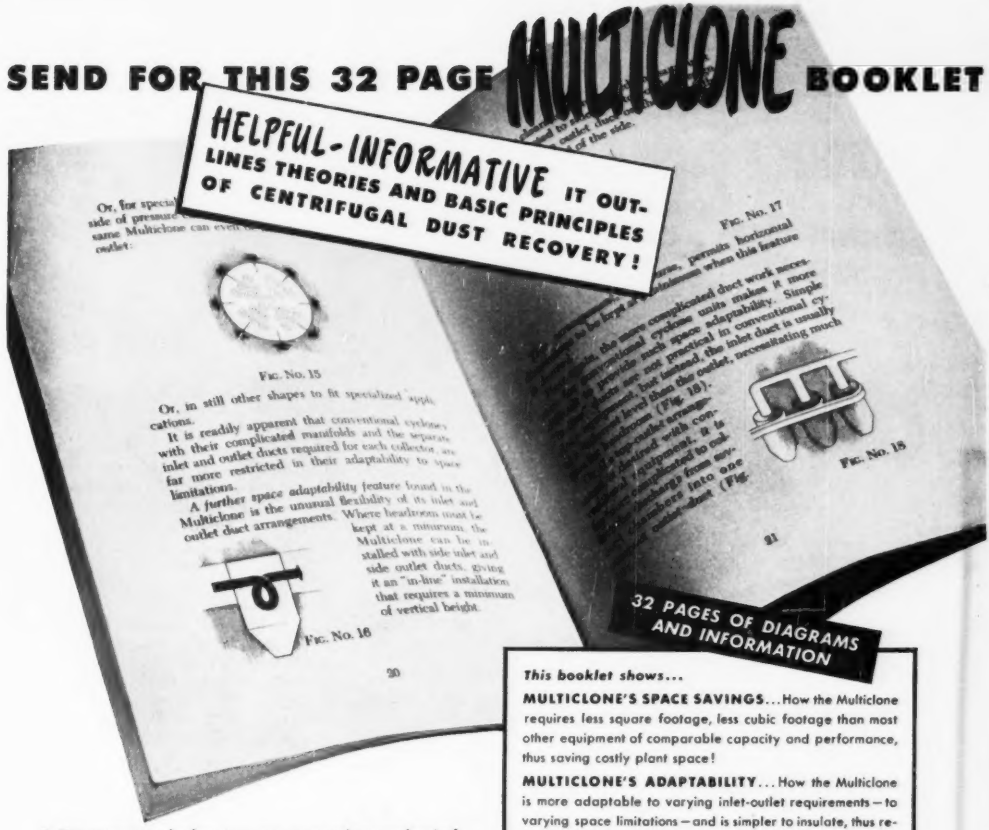
Fig. No. 15
Or, in still other shapes to fit specialized appli-
cations.
It is readily apparent that conventional cyclones
with their complicated manifolds and the separate
inlet and outlet ducts required for each collector, are
far more restricted in their adaptability to space
limitations.
A further space adaptability feature found in the
Multiclone is the unusual flexibility of its inlet and
outlet duct arrangements. Where headroom must be
kept at a minimum, the
Multiclone can be in-
stalled with side inlet and
side outlet ducts, giving
it an "in-line" installation
that requires a minimum
of vertical height.
Fig. No. 16
20
Fig. No. 17
Fig. No. 18
21
32 PAGES OF DIAGRAMS AND INFORMATION

NO MATTER whether you are now using mechanical dust recovery equipment or are planning the installation of such equipment at some future date, here is a booklet that is full of helpful and valuable information on centrifugal dust recovery. It not only explains the basic methods and principles involved, but also shows the important differences between small and large diameter separating tubes, shows how to simplify your duct work and reduce installation costs, and outlines many other important factors to be considered in selecting mechanical dust recovery equipment.

In addition, this informative booklet illustrates and explains how MULTICLONE'S unique *vane* design is fundamentally different...how it makes possible greater compactness, simpler installation, high recovery of the small particles as well as the medium and coarser ones, and many other facts on MULTICLONE advanced design.

A limited supply of these booklets is available for free distribution to those interested in mechanical recovery equipment and methods. Write for your copy today.

This booklet shows...

MULTICLONE'S SPACE SAVINGS...How the Multiclone requires less square footage, less cubic footage than most other equipment of comparable capacity and performance, thus saving costly plant space!

MULTICLONE'S ADAPTABILITY...How the Multiclone is more adaptable to varying inlet-outlet requirements—to varying space limitations—and is simpler to insulate, thus reducing installation costs!

MULTICLONE'S EFFICIENCY...How Multiclone's multiple *small diameter* tubes, made possible by its exclusive vane design, give higher centrifugal forces and more complete cleansing of *all* suspended particles—even small ones of 10 microns and less!

MULTICLONE'S LOW MAINTENANCE...How the Multiclone has no high speed moving parts to repair or replace, no pads or filters to clean or renew, nothing to choke gas flow or increase draft losses as suspended materials are recovered. Multiclone draft losses remain uniformly low—recovery efficiencies uniformly high—at all times!

Make sure that a copy of this helpful booklet is in your reference files by sending for your copy now!

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COTTRELL Precipitators · MULTICLONE Collectors · TURBULAIRE Spray Dryers

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REDUCE your street light control COSTS

with

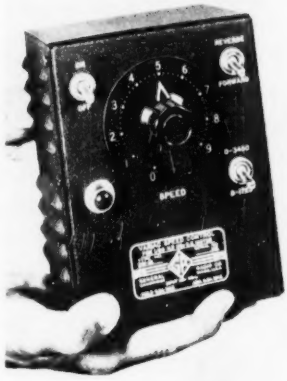
FISHER-PIERCE PHOTOELECTRIC CONTROLS

Improved lighting service is available to cities and towns through the use of photoelectric controls by Fisher-Pierce. These units are giving continuous, positive service in hundreds of modern applications . . . regardless of weather, climate or daylight conditions.

Approved by cost-conscious engineers, Fisher-Pierce controls offer a simplified photo-relay for control of multiple or series street lighting systems. F-P economies include long tube life (20,000 hours or more), easy servicing (simple plug-in chassis construction), *no resetting after power interruptions.* In other words, exceptionally *low maintenance costs.* We'd like to give you details on our units for improved street lighting. A request will bring full information promptly.

FP *The* FISHER-PIERCE COMPANY, INC.

82 CEYLON ST., BOSTON 21, MASSACHUSETTS



to nearly zero at constant torque.

Two models of this speed control are available: Type 1701-AK for operating a 1/20 hp d-c shunt motor, and Type 1701-AU for operating a 1/15 hp universal motor. A working speed range of 30:1 is reportedly obtained with shunt motors and at least 50:1 with most universal motors.

A slow-blow fuse serves as protection against damage from stalling when starting under excessive load. Controls are housed in a 6-lb metal cabinet about 7x6x5 in.

General Radio Co, 275 Massachusetts Ave, Cambridge 39, Mass.

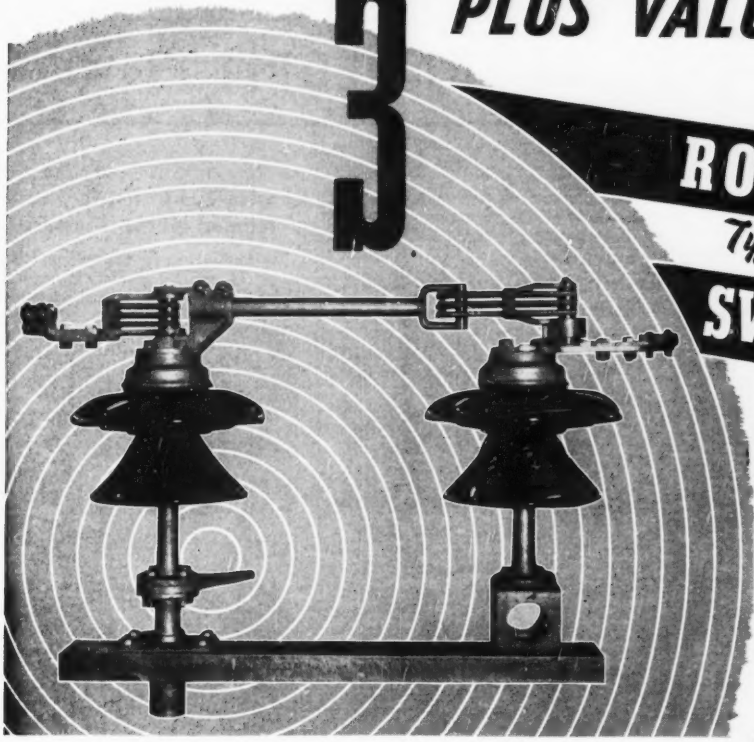
•

Trouble Light

AN EXTENSION CORD trouble light, Model 110 Flex Lite, is designed to operate on 110 v in place of flashlight batteries. Lamp is at the tip of a 12-in. flexible neoprene-covered extension, and is equipped with a neoprene service cord 12 ft long. Light bulb is protected by a guard of approximately $\frac{5}{8}$ in. diam.

Aero-Motive Mfg Co, 1803 Alcott St, Kalamazoo 24, Mich.

3 PLUS VALUES OF ROYAL Type RLL SWITCHES



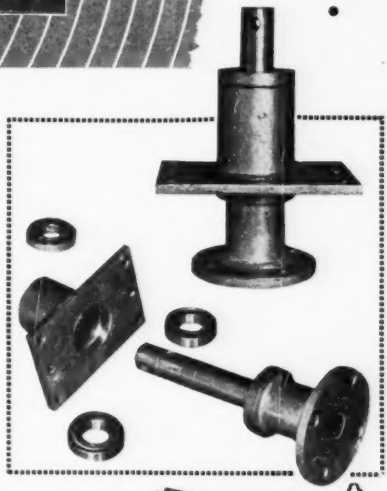
1 SIMPLICITY OF DESIGN

2 HIGH PRESSURE POINT CONTACTS

*3 SEALED BALL BEARINGS

* 3. SEALED BALL BEARINGS:

The bearings under the rotating insulator of Royal's type RLL switch are permanently sealed ball bearings packed in a special Silicone lubricant which stays fluid from sixty below to 150° F. This bearing was developed for the U. S. Army Air Force. It never requires adjustment, regardless of load. Dirt and corrosion are permanently sealed out. These bearings have a combined radial and thrust safety factor of four, based on the heaviest loads they were designed to carry.



The ROYAL Display Wagon will demonstrate this switch at your door. Watch for it

Other features service proved for 12 years . . .

1. No braids anywhere
2. Oilite hinge bearings to eliminate corrosion
3. Adapters punched to take grounding blade
4. Continuous, annular high pressure contacts at hinge and jaw ends

The Royal Type RL switch listed on pages 158, 159, 169 and 170 of Catalog No. 11 is a center rotating double break design incorporating these same mechanical and electrical features.

A copy of this catalog will be sent to you upon request.

35 YEARS
A Part of the Arsenal of
AMERICAN POWER PRODUCTION

Royal ELECTRIC MANUFACTURING COMPANY
INCORPORATED
1122 EAST 87th STREET Chicago 19, Ill.
Designers and Manufacturers of Power Switching Equipment and Special Electrical Devices

NEWS ABOUT PEOPLE

Rice New Vice-President of West Penn Electric Co

J. Lee Rice, Jr, treasurer of West Penn Electric Co, has been elected a

J. LEE RICE, JR

vice-president of the holding company. He has been a director since 1946.

Rice served with the Associated Gas & Electric Co System in financial and treasury work from 1925 to 1944. He was elected treasurer of Associated G&E and most of its important subholding companies in 1939.

In 1944 he joined American Water Works & Electric Co, Inc, and in 1945 became treasurer of that company and its electric holding company subsidiary, West Penn Electric. He remained with the latter company after dissolution of the parent.

Rice is also a vice-president, director, and member of the executive committee of Potomac Edison and a director of West Penn Railways Co, both West Penn Electric subsidiaries.

•

Philip R. Nalder, electrical engineer, has been appointed assistant district manager of the Bureau of Reclamation's Columbia Basin project in eastern Washington. He has been with the Bureau since 1933 except for military service.

E. S. Neighbors has been appointed superintendent of the electrical department of Birmingham Electric Co. He succeeds A. G. Morton, who has been made consultant. Neighbors, a member of the American Institute of Electrical Engineers, has been with the line division for more than 20 years and with the company since 1927. Morton, who has been with Birmingham Electric since 1901, has served as supervisor of the street lighting division, head of the meter department, and superintendent of lines and meters. He also is a member of AIEE.

•

Rochester G&E Forms Operations, Planning Unit

A new department of electric operations and planning has been formed by Rochester Gas & Electric Corp to supervise load dispatching and system planning. H. J. Klumb will be superintendent, with headquarters at the main office.

G. H. Fiedler will become superintendent of electric distribution, with H. A. Brown as assistant superintendent. I. G. McChesney will be assistant superintendent of electric operations and planning. W. F. Van Horn has been appointed assistant superintendent of electric and steam generation but will retain his duties as superintendent of meter, laboratory, and appliance testing.

•

A. R. van C. Warrington, section engineer at General Electric Co's switchgear divisions, Philadelphia, since 1928, and a specialist in distance relaying, has been made engineer in charge of meters and instruments for English Electric Co, Stafford, England. His successor at GE will be H. T. Seeley, with the company since 1922. Warrington, a fellow of the American Institute of Electrical Engineers, joined GE in 1925 at the Schenectady works.

Dudley M. Arnold has been elected assistant secretary and assistant treasurer of Pennsylvania Power Co. Arnold started with the company in 1928 as a clerk in the rate department. In 1929 he became chief clerk of the customers accounting department in New Castle, in 1936 division auditor, and in 1942 general supervisor of customers accounting.

Charles T. Lawson Is Named NEMA President

Charles T. Lawson, vice-president in charge of sales, Kelvinator Division, Nash-Kelvinator Co, Detroit, is the

CHARLES T. LAWSON

new president of the National Electrical Manufacturers Association. He succeeds B. W. Clark, vice-president in charge of sales, Westinghouse Electric Corp, Pittsburgh.

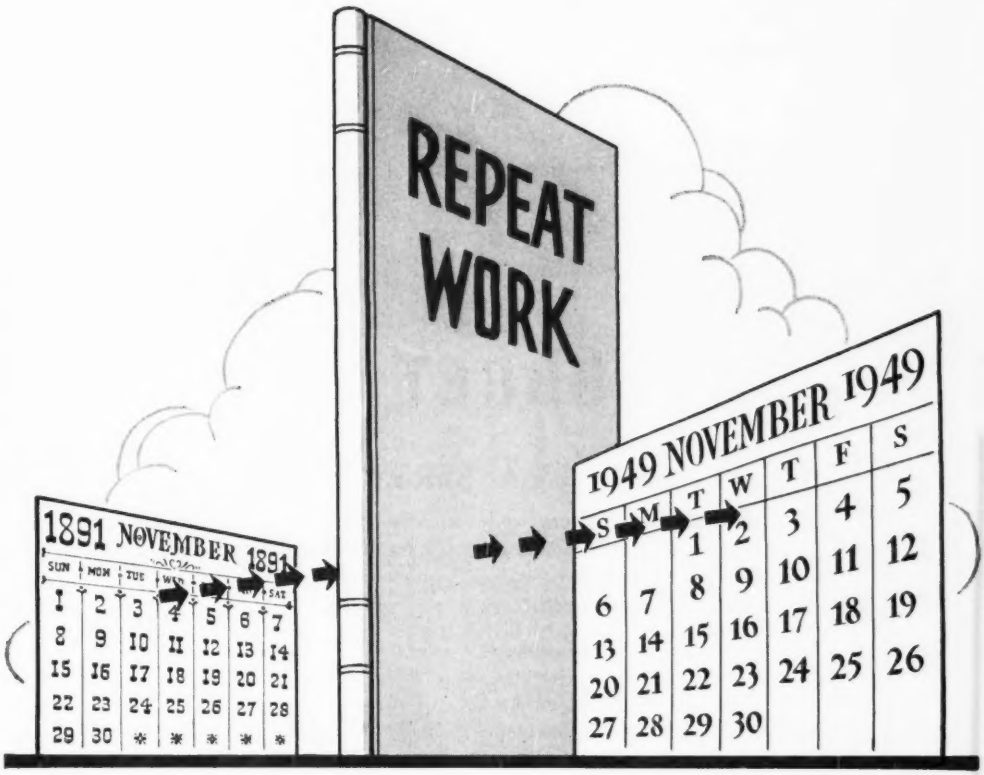
Lawson left Westinghouse's engineering department after World War I to begin his sales career. In 1921 he joined Day Fan Electric Co, Dayton, O., becoming general sales manager in 1924 and vice-president in 1926.

From 1929 to 1932 Lawson was general sales manager of General Motors Radio Corp at Dayton. He became an executive of Frigidaire in 1932 and two years later was made household sales manager. Lawson joined Kelvinator in 1939, became household sales manager; in 1941, general sales manager; and in 1943, vice-president.

•

Dean Frederick M. Feiker of the School of Engineering of George Washington University has been given the Washington Society of Engineers' award, presented only three times in the 44 years of the group's existence. Feiker was editor of ELECTRICAL WORLD from 1915 to 1918 and a vice-president of McGraw-Hill Publishing Co from 1918 to 1920. He has also served as assistant to Secretary of Commerce Herbert Hoover, operating vice-president of the Society

A MEASURE OF SATISFACTION



80% of all the construction work we have completed since 1891 has been for clients previously served—a tangible measure of client satisfaction.

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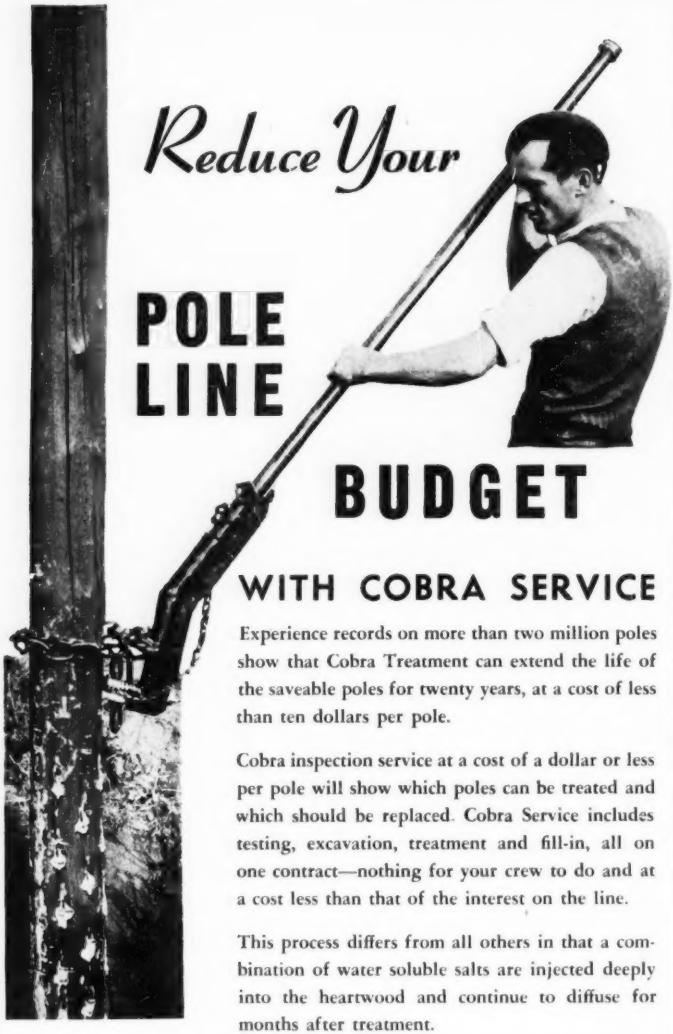


Reduce Your

POLE LINE BUDGET

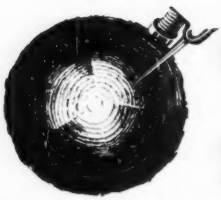
WITH COBRA SERVICE

Experience records on more than two million poles show that Cobra Treatment can extend the life of the saveable poles for twenty years, at a cost of less than ten dollars per pole.

Cobra inspection service at a cost of a dollar or less per pole will show which poles can be treated and which should be replaced. Cobra Service includes testing, excavation, treatment and fill-in, all on one contract—nothing for your crew to do and at a cost less than that of the interest on the line.

This process differs from all others in that a combination of water soluble salts are injected deeply into the heartwood and continue to diffuse for months after treatment.

Technical data, laboratory tests, lists of users and samples of the Cobra inspection report will be sent on request.



COBRA
WOOD-POLE
SERVICE

COBRA WOOD TREATMENT CORPORATION
124 EAST 40TH STREET • NEW YORK 16, N. Y.

for Electrical Development; managing director of Associated Business Papers, Director of the Bureau of Foreign and Domestic Commerce, and executive secretary of the American Engineering Council.

Heinz M. von Foerster, formerly attached to the American army information service in Austria, has been appointed a special research assistant professor of electrical engineering at the University of Illinois. He has held research positions with German and Austrian electrical equipment makers.

Charles E. Hickey, manager of the outside plant construction department of Consolidated Edison Co of New York, has retired after 41 years of service with the company. He started with the New York Edison Co in 1905 as a meter tester and joined Consolidated Edison in 1937 as manager of the distribution operation department.

Walter H. Sammis, president of Ohio Edison Co, Akron, has been re-elected vice-president of the Ohio Chamber of Commerce for the coming year.

OBITUARY

Cornelius W. DeForest

Cornelius W. DeForest, 72, former vice-president of a number of Columbia Gas & Electric Co subsidiaries, died Nov 17 in Washington, D. C. At the time of his death DeForest was acting as a consultant to the Economic Cooperation Administration on rebuilding the power supply facilities of Marshall Plan countries.

DeForest entered the electric utility industry in 1896, when he joined the meter department of Brooklyn (N. Y.) Edison Co. Later he worked for General Electric Co in test and construction; United Electric Light & Power Co, New York; Union Light, Heat & Power Co, Covington, Ky., as chief engineer; and Union Gas & Electric Co, Cincinnati, as electrical engineer, manager of the electrical department, and vice-president.

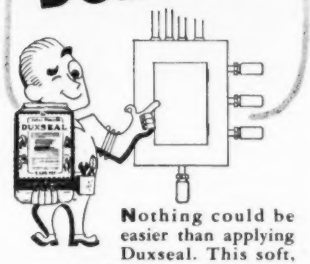
Before 1935 he also served as vice-president of Columbia Power Co and Columbia Engineering & Management Corp, both Columbia G&E subsidiaries. From 1935 until his retirement in 1944 DeForest was chief engineer of Cincinnati Gas & Electric Co. He played a major part in the design and construction of West End and Miami Fort Stations in Cincinnati and the adding of superposed units in the Tait Station in Dayton.

DeForest served as chairman of various committees of Edison Electric Institute and Association of Edison Illu-

HANDY ANDY SAYS:

Pluggin's a soft job . . . with

Johns-Manville DUXSEAL



Nothing could be easier than applying Duxseal. This soft, permanently pliable plastic putty goes right into place in openings around service boxes, cable entrances, conduit ends, drill holes in foundations . . . makes a smooth, finished-looking job in a matter of seconds. Every electrician should keep a convenient, handy package of Duxseal in his tool box for on-the-spot use . . .

Remains soft—Duxseal stays soft indefinitely, but will not slump, melt or run under ordinary temperatures.

Remains tight—Clings to duct walls and cables but gives with expansion or contraction of the cable.

Remains insoluble—Unaffected by ground waters and gases.

Remains harmless—Will not injure workmen's hands or react with rubber, metals or painted surfaces.

Tight seals for other electrical uses:

J-M Tranolseal . . . for use with electrical equipment using dielectric oils.

J-M Uniseal . . . for caulking against weather and humidity. Resists temperatures up to 180 F.

If you would like to know more about Duxseal and other J-M labor-saving sealing compounds, write Johns-Manville, Box 290, New York 16, N. Y. In Canada, write 199 Bay Street, Toronto, Canada.

JM

Johns-Manville

SEALING COMPOUNDS

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is waiting . . .

When you are involved with financial printing you want to go places and do things in a hurry. *SPEED* is of the essence.

The chauffeured station wagon maintained by Sorg, ready to roll on a moment's notice twenty-four hours a day, typifies Sorg Service . . . every detail of which is geared to the handling of your needs accurately under pressure.

To satisfy your financial printing requirements, it will be to your advantage to make Sorg responsible. Leading utility companies avail themselves of Sorg Service for reports, registration statements, prospectuses, indentures, proxy solicitation material, etc., because Sorg delivers both day and night . . . with accuracy and on time.

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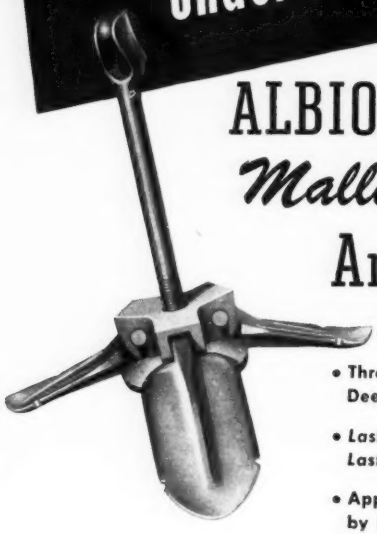

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- ***Lasting* Strength Gives Them *Lasting* Holding Power**
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minating Companies and was a member of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Engineering Society of Cincinnati.

In 1945 the United States Army sent him to Germany to investigate the extent of war damage to electrical facili-

CORNELIUS W. DEFOREST

ties for the military government, and in 1948 he became technical advisor on all electric power projects coming under ECA.

•

Dr Frank B. Jewett

Dr Frank B. Jewett, 70, former president of Bell Telephone Laboratories, died Nov 18 in Summit, N. J., after a short illness.

One of the nation's best known scientists, Jewett was a former president of the American Institute of Electrical Engineers and the National Research Council. For his work with the latter organization and the Office of Scientific Research and Development during World War II, he was awarded the Medal for Merit, top civilian award of the federal government.

Jewett taught physics and electrical engineering at Chicago University and Massachusetts Institute of Technology before joining American Telephone & Telegraph Co in 1904 as a transmission engineer. In 1912 he was made assistant chief engineer of Western Electric Co, the firm's manufacturing unit. When Bell Telephone Laboratories was formed in 1925 he became its first president and held that post until 1940, when he was named chairman of the board. When Jewett retired from Bell in 1944, he also was a vice-president of AT&T.

He was the author of numerous scientific papers and received a number of awards. Among the latter were the AIEE's Edison Medal; the Institution of Electrical Engineers of Great Britain's Faraday Medal; the Franklin Institute's Franklin Medal; the Western

DR FRANK B. JEWETT

Society of Engineers' Washington Award; the Distinguished Service Medal; and the John Fritz Gold Medal awarded by the four national engineering societies.

•

Herbert L. Ogden, 78, for many years purchasing agent of the former Massachusetts Utilities Associates, Boston, died at Melrose, Mass., Nov 22. Ogden was assistant purchasing agent of the New England Power Service Co after what is now New England Electric System took over the MUA properties. He retired in 1947. He was the last surviving charter member of the New England Purchasing Agents Association.

Walter W. Carson, manager of rural service for West Penn Power Co since 1937, died Nov 14 in Pittsburgh after an illness of several weeks. He joined West Penn as a salesman at Monongahela in 1918 and was Monongahela district manager from 1922 to 1937. Two months ago Carson was elected chairman of the Pennsylvania section of the American Society of Agricultural Engineers. He also was a member of the EEI Farm Utilization Committee.

Daniel A. McKenzie, an electrical engineer with Ontario Hydro Power Commission for the past 37 years, died Nov 17 in Toronto. During his service with Ontario Hydro, McKenzie built several plants, including the Thunder Bay project, and was instrumental in opening up many northern Ontario properties. He was a member of the American Institute of Electrical Engineers, the Institute of Electrical Engineers of England, and the Association of Professional Engineers of Ontario.

Gerald William McCrady, 56, who was the engineer in charge of installing the turbines at Shasta Dam, died last month in Redding, Calif. He also had worked on turbine installations at Hoover Dam.

THE T.J. Cope INC. REPORTER

Written by Edgar W. Baird, Jr., President T. J. Cope, Inc., Philadelphia, Pennsylvania

Less Labor and Lower Costs are the desire of everyone who is cost conscious. That's why I've dwelt from time to time in the Cope Reporter on items that produce savings in labor and reduce costs of installation. New methods and new materials invariably require new tools and new equipment. Such has been the evolution of the COPE SERVICE CABLE HOOK.

Assembled cable has greatly simplified service entrance installations for homes, etc. It has made unnecessary the expensive and unsightly brackets required by the three-individual-wire type of installation. All one need do, after attaching the bail wire clamp, is to place the flexible bail wire loop around the COPE SERVICE CABLE HOOK. Results: *Simple installation—best construction—low cost.*

The COPE SERVICE CABLE HOOK—made of malleable iron, hot galvanized and weighing only five ounces—can be easily mounted on any wall, pole or cross arm. It was carefully designed, at customers' requests, to eliminate the possibility of slipping off and cutting of the bail wire encountered with other types of attachment. A short note from you will bring full description and prices.

If you were told that the cost of an operation could be "reduced by about 97%, with work speeded up in about the same proportion", you would certainly sit up and listen. And if you are in any way responsible for the purchase or use of equipment for rodding ducts, you will want to know all about the COPE PNEUMATIC FISH LINE that produces such savings. I ask that you *carefully read* what Mr. J. C. Strasbourger of the Cleveland Illuminating Company had to say in a recent article in Electrical World about such type of equipment:

"Another recent addition to our staff of mechanical helpers is a pneumatic machine to drive a line through underground cable ducts. No doubt some other companies are already using this device. Previously our practice was to push through a series of interlocking wood or steel rods. This was a slow, laborious hand operation and very expensive, particularly on long sections of duct. In about 2 minutes the new device shoots a neoprene cup and following wire through a 600-ft duct section. The cost of this operation has been reduced by about 97%, with work speeded up in about the same proportion."

Similar savings by other users of the COPE PNEUMATIC FISH LINE have more than justified the purchase of two or more units for their underground crews. You, too, *can afford* to have one but *can't afford* to be without one!

We have an ample supply of descriptive literature on the COPE SERVICE CABLE HOOK and the COPE PNEUMATIC FISH LINE. It naturally will be to your advantage to know more about this latest cost-reducing equipment. May we therefore have the pleasure of supplying you with such information?

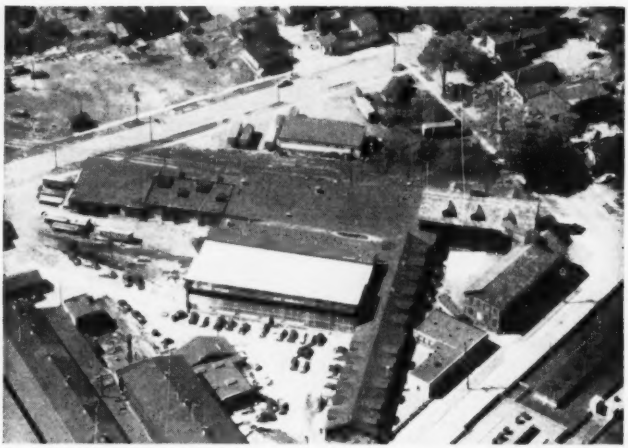
Sincerely,

E. W. Baird Jr.

T. J. COPE, Inc.

711 S. 50 St. Philadelphia, Pa.

MANUFACTURERS and MARKETS



IN CELEBRATION of its thirtieth anniversary, Standard Transformer Co has launched a $100,000 expansion program at its plant in Warren, Ohio. The new addition (light roof) stands out in this air view looking southwest. Lower right is the company's one-story office building. Facilities in the new brick, steel, and glass addition will make possible the manufacture of units with up to 25,000 kva capacity

MANUFACTURING BRIEFS

Reynolds Metals Co has reduced its prices on steel-reinforced aluminum cable by 1⅞¢ to as much as 4.31¢ a pound. ACSR now is being shipped by Reynolds at a rate of 2 million lb a month.

The millionth electric blanket produced by General Electric Co since it introduced the first commercial item of this kind 13 years ago was manufactured this month. In a little more than 12 years the industry has marketed 1,724,000 electric blankets, indicating a public acceptance unusual in the electrical appliance business, David Spooner, Jr, manager of GE's automatic blanket and sunlamp division, said. It took the industry 18 years to sell a million refrigerators and 20 years for ranges.

A unique Westinghouse Electric Corp "management school" is enrolling supervisors—from foremen to managers—to study the latest principles of successful management at various company plants. Organized by the firm's management development service, the school emphasizes human relations and their application to specific management problems. The first course already has been conducted for Westinghouse plants at Sharon, Pa.; Cleveland; and Springfield, Mass.

Refrigerator sales by Kelvinator Division of Nash-Kelvinator Corp hit a new peak during fiscal 1949. The company sold 8% more refrigerators this year than in 1948, the best previous year.

Robbins & Myers, Inc, Springfield, O., electric fan manufacturer, has affiliated with Hunter Fan & Ventilating Co, Memphis.

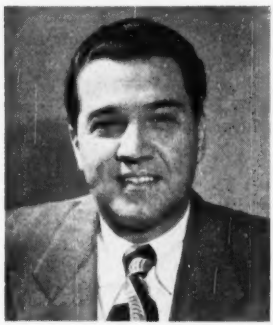
A new unit, Overseas Business Services, has been formed by McGraw-Hill International Corp to serve industry on overseas problems. Available to outside firms on a fee basis, its services will include confidential reports on any phase of the firm's overseas business, market studies, economic surveys, special export counsel, production of industrial movies, picture and/or story procurement, and translations. A new monthly promotion bulletin, *McGraw-Hill International Trader*, will coordinate miscellaneous information on foreign trade.

•

Hotpoint, Inc, Reshuffles Marketing Organization

To strengthen and coordinate its marketing programs, Hotpoint, Inc, has reshuffled its marketing organization.

Changes made include formation of a new Electric Utility Division, headed by D. R. Anneaux. On his staff will be W. L. Leavis, eastern regional utility manager, with headquarters in Boston; A. H. Jaeger, Pacific manager, Seattle; A. W. Peterson, Western manager, Chicago; J. A. Bell, Central manager, Chicago; and E. R. Sigler, utility representative on special assignments.



D. R. ANNEAUX

The divisions of the department directly related to merchandising and selling, including the field organization, merchandising division, and key account specialists, have been placed under E. R. Taylor, sales manager. Other sales units, including the building division, headed by L. E. Stratton; product divisions; and the utility division, will report to F. J. Walters, vice-president, who will have E. E. McEwan as his assistant. The managers of the product divisions, R. C. Cameron, on electric kitchens; D. J. Irvine, range and water heaters; F. M. Slasor, refrigeration; and L. I. Sweetland, home

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- (i) Lighting and Safety ☐
- (j) Industrial Relighting ☐
- (k) HIBAY* Lighting ☐
- (l) Small-Store Lighting ☐
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- (o) Broadcasting Studio ☐

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- (e) Commercial Semi-Indirect ☐
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NO. 3 ENGINEERING FOLDERS:

- (a) Recessed HOLOFLUX* (Fluorescent) ☐
- (b) Surface-Attached HOLOFLUX (Fluorescent) ☐

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- 5 ADVANCED LIGHTING DESIGN WITH CONTROLENS* ☐
- 6 THE LIGHTING OF SWITCHBOARDS ☐
- 7 THE LIGHTING OF GENERATING AND SUB-STATIONS ☐
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- 9 LIGHTING THE MODERN JEWELRY STORE ☐
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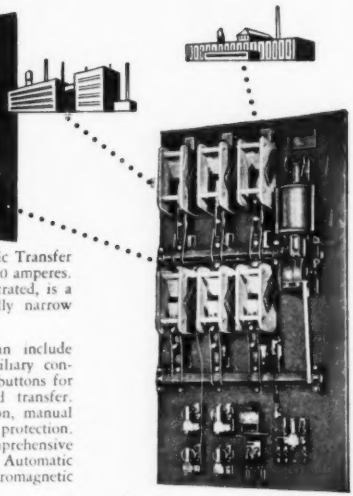

We can take care of almost any Automatic Transfer Switch requirement ranging from 5 to 1000 amperes. For example, Bulletin 906-105S, as illustrated, is a 300 ampere unit installed in a specially narrow panel for a distribution control center.

Standard features on control panels can include phase failure protection, indicating auxiliary contacts, engine starting contacts and push buttons for engine tests, reset to normal and load transfer. Special features include delayed operation, manual emergency handles, low frequency relay protection. Condensed Catalog No. 700 gives a comprehensive picture of our work along the line of Automatic Transfer Switches and complete Electromagnetic Control Panels.

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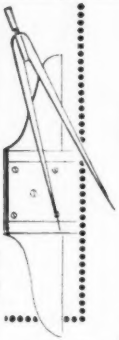

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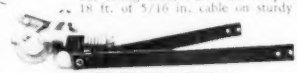
HEAVY DUTY DRAWBAR "H"
For use with 3 and 5 ton pole trailers. Has coupling eyes to fit standard pintle or towing hooks. Length 30 inches; width 5 inches. Tightners 8 inches apart. Weight 55 lbs.



1417 PINTLE HOOK
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— to pick up and coil wire, rope, etc. neatly and quickly. Collapsible — for easy removal of coiled wire or rope. Attaches to winch shaft. Light weight aluminum — sturdy construction. A great time saver.

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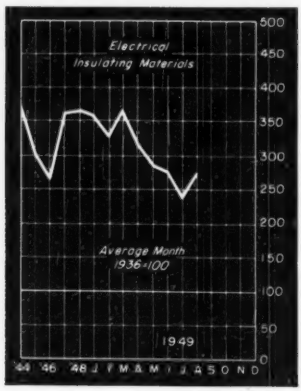
laundry, have been designated staff assistants.

J. F. McDaniel has been promoted to assistant sales manager. Operating from the Chicago headquarters as key account specialists will be D. E. Anderson and E. J. Sorenson. Field organization managers remain essentially unchanged.

•

Insulating Material Sales Rise 14% During August

Sales billed on electrical insulating materials during August, 1949, moved up again after a July decline. The in-



dex compiled by the National Electrical Manufacturers Association stood at 273, a 14% increase over the 240 recorded for July.

August sales still were well below the same period of 1948, when the index stood at 354. The drop was 23%.

•

Steel Fabricator to Enter Home Appliance Field

Murray Corp of America, steel fabricator and one of the nation's largest producers of automotive bodies and assemblies, will enter the "moderate-priced" home appliance field early in 1950.

The company will distribute under the Murray name a full line of gas and electric ranges, matched steel kitchens, cabinet-sinks, and base and wall cabinets through appliance distributors. Design and production tooling are expected to be completed by the end of the year, and the first public showing will be at Chicago's Merchandise Mart in January. A quarter-mile-long plant in Scranton, Pa., has been built for the new home appliance division at an estimated cost of more than $7 million.

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NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Calif., El Centro—Imperial Irrigation dist., El Centro, furnishing, erecting 300,000 lbs. per hr. steam generating unit, Spec. 308. $500,000.

Idaho, Montana, Washington—Northern Idaho Rural Electric Rehabilitation Assn., Inc., Sandpoint, Idaho, 168.87 mi. rural distr. lines, Bonner and Boundary Counties, Idaho; Lincoln and Sanders Counties, Mont.; and Pend Orielle Co., Wash., R. E. A. Proj. Idaho 4V Bonner. Approx. $50,000. Plans deposit $25. H. A. & J. A. Sewell, Newport, Wash., engrs.

Kan., Scott City—Frank Horton & Co., consult. engrs., Lamar, Mo., 85x100 ft., steel, corrugated asbestos power plant, foundations for three 2300 kw engine generator units, plumbing, sewerage, drainage, yard piping, foundations for fuel oil tanks, cooling tower, substation structure and apparatus for Wheatland Electric Co-operative, Scott City.

Mich., Ypsilanti—Admin. Bldgs. Div., A. N. Langius, dir., 115 A State Office Bldg., Lansing, concrete brick, structural steel power plant and connecting services, sewerage, for State Normal College, $500,000. E. R. Little Co., 1807 Kales Bldg., Detroit, consult. engr.

Okla., Blackwell—City, 2 steam turbines and generators for Blackwell Power Plant. $600,000. Black & Veatch, 4706 Broadway, Kansas City, Mo., engrs.

Okla., Cherokee—City, voted bonds, 1,100 hp. diesel engine at light plant. $135,000. C. H. Guernsey, 1410 N. Robinson St., Oklahoma City, consult. engr.

Okla., Perry—City, c/o R. W. Wilson, Clk., Perry, one 1,250 hp. diesel engine and generator unit, one switch board and one cooling tower. $150,000. Wayne Clement, Perry, engr.

Wash., Arlington—Pub. Wks. Officer, 13th Naval Dist., 1611 W. Wheler St., Seattle, 115,000/4160 volt substation at Jim Creek Naval Communications Station, Spec. No. 23228. Plans deposit $10. Extended date.

Low Bidders & Contracts Awarded

California—Bureau Reclamation, Box 2511, Sacramento, steel towers for 239 kv transmission lines, Shasta-Tracy West Side Lines, double circuit steel towers for Central Valley, Proj., Spec. R-2-74, Shasta Co., etc. to Bethlehem Pacific Coast Steel Corp., 20 and Illinois Sts., San Francisco, $1,844,414. Bids 10/18.

California—Bureau Reclamation, Elverta, two 230 kv transmission lines from Perkins to Tracy Oroville to Elverta, Central Valley Proj., Butte and San Joaquin Counties, etc., Spec. 2781, Schedule I, to Murlack Co., Inc., 2277 Jerrold Ave., San Francisco, $434,163; Schedule II, to Barrett & Hilp, 918 Harrison St., San Francisco, $113,956. Bids 11/7.

Kansas—Northwest Kansas Electric Co-operative, Bird City, 308 rural distr. lines, Rawlings and Cheyenne Counties, Proj. Kansas 49D-1, Cheyenne, to A. F. Rele, National Bank Bldg., Topeka, $313,-051. Bids 11/3.

Kentucky—U. S. Eng., 303 U. S. Court House, Nashville, 1, Tenn., completing Wolf Creek Power Plant, approx. 10 mi. north of Albany, Cumberland River, Russel Co., CIVENG-40-058-50-3, to E. J. Albrecht Co., 2616 S. 56 St., Chicago 8, Ill., $3,558,719. Bids 10/27.

Missouri—Barry Electric Co-operative, Cassville, 69.48 mi. rural distr. lines and converting 6.5 mi. lines, Barry and MacDonald Counties, to Wedding Constr. Co., Cloverport, Ky. $98,000. Bids 10/17.

South Carolina—Blue Ridge Electric Co-operative, Inc., Pickens, Nov. 14, 98.94 mi. rural distr. lines, Oconee and Anderson Counties, from Little Electric Co., Hartsville, $113,746.

Texas—Comanche County Electric Co-

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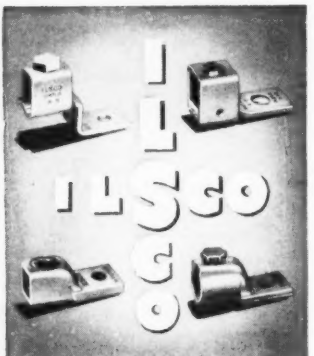

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INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Calif., Hayward—Eden Hospital Dist., Hayward, voted $1,128,000 bonds, 118-bed hospital, at Eden, near here. **$2,600,000.** Douglas D. Stone & Lou B. Mulloy, 619 California St., San Francisco, archts. Garthorne, Buonaccorsi & Murray, 1095 Market St., San Francisco, consult. engrs.

Conn., Bridgeport—City, Anthony D. Cirest, chn. Bridgeport Housing Auth., 11 apartments, 264 family units, Lexington Ave., $2,500,000; 21 bldgs., 54 dwelling units garden apartments, $4,000,000. Harry Lindsay, 211 State St., archt.

Fla., Tampa—Tampa Housing Auth., Tampa, 1500 housing units, **$5,000,000.**

Mich., Ann Arbor—University of Mich., Bd. Regents, Robert P. Briggs, vice pres., Room 2024 Admin. Bldg., 9 story, 424x216 ft. irregular shaped, rein.-con., structural steel, masonry men's dormitory, $5,000,000, Plans deposit $100. Andrew R. Morison, 713 Fox Bldg., Detroit, archt. Philip J. Endlich, 1806 Oakman Blvd., Detroit, archt. Philip J. Endlich, 1806 Oakman Blvd., Detroit, engr.

Mich., Dearborn—Oakwood General Hospital Assn., Dearborn, plans by Henry F. Stanton, Free Press Bldg., Detroit, 5 story, rein.-con. structural steel, masonry, glazed tile, hospital. **$3,000,000.**

Mich., Lansing—Mich. State Capitol Bldg. Comn., Lansing, plans by Smith, Hinchman & Grylls, 800 Marquette Bldg., Detroit, 8 story, rein. con., masonry, steel, state office headquarters, **$4,000,000.**

N. Y., Newark—Dpt. Mental Hygiene, Albany, 2 infirmary bldgs. at State School. $2,000,000. Plans deposit $30. DeYoung & Moscowitz & Rosenberg, 205 E. 42 St., New York, Zone 17, archts.

O., Cleveland Heights—Bd. Educ., 1749 Lee Rd., voted bonds, elementary school and Junior High School; 2 elementary schools and one Junior High School addns. **$2,750,000.**

O., Elyria—Elyria Bd. Educ., Middle Ave., voted bonds, remodel and addns. to 8 schools and 2 new Junior High Schools. **$3,700,000.** Outcalt & Guenther & Assoc., 13124 Shaker Sq., Shaker Heights, archts.

O., Parma—Bd. Educ., 5401 W. 54 St., Cleveland, voted bonds, high school, W. 54 St. and Linwood Ave.; elementary school at Commonwealth and Blossom Rds. **$3,250,000.** Fulton, Krinsky & Delamotte, 6014 Euclid Ave., Cleveland, archts.

S. C., Spartanburg—Spartanburg Housing Auth., Spartanburg, 400 housing units, **$2,500,000.**

Tex., Houston—St. Luke's Methodist Church, 3350 Westenheimer St., plans by Mark Lemmon, 1210½ Main St., Dallas, (1st unit), church and associated bldgs., **$650,000;** (2nd unit) church and associated bldgs., **$850,000,** on 3600 blk. Westheimer, 14 acre tract.

Low Bidders & Contracts Awarded

Calif., Sacramento—State Div. Architecture P. Wks. Bldg., Nov. 15, general contract 6 story, bsmt., rein.-con., structural steel, 340,000 sq. ft., State Capitol Annex bldg., from Swinerton & Walberg, 225 Bush St., San Francisco, **$1,155,729***** heating, ventilating and air-conditioning, from S. Glen Hickman, 317 E. 11 St., Los Angeles, **$610,725*****plumbing, from Victory Eng. & Electric Co., 1245 Riverside Dr., Los Angeles, **$574,274*****electrical work, from Westinghouse Electric Co., 410 Bush St., San Francisco, **$361,580.**

Ill., Maplewood (East St. Louis P. O.)—School Dist. 187 of St. Clair Co., c/o Bd. Educ., Harold Anglim, secy., general contract 2 story, bsmt., brick, rein.-con, Cahokia Commonfield High School, to John J. Keeley Constrg. Co., 2030 State St., East St. Louis, **$1,791,906.** Bids 10/10.

Md., Towson—Rodgers Forge Apartments, Loch Raven Village, Towson, nineteen, 2 story, brick, block bldgs., Sect. 2, Rodgers Forge and Dumbarton Rds., to Rodgers Force Constr. Co., Loch Raven Village, Towson. **$1,006,332.**

N. C., Gastonia—Eastover Apartments, Inc., c/o contractor, 100 apartment units, to C. D. Spangler Constr. Co., 1933 S. Blvd., Charlotte, Approx. **$600,000.**

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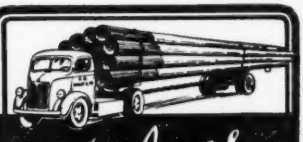

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RECENT RATE CHANGES

Pennsylvania Water & Power Co's proposed rate tariff has been rejected by the Federal Power Commission, which prescribed other schedules covering the Baltimore company's sales of electric energy to Pennsylvania Power & Light Co, Philadelphia Electric Co, Metropolitan Edison Co, and Consolidated Gas, Electric Light & Power Co of Baltimore. Penn Water filed the proposed tariff under an FPC order of last Jan 5 directing the company to reduce its rates to the four customer companies by an aggregate amount of $1,954,261 yearly. In rejecting the tariff the Commission noted that (1) Penn Water filed on behalf of itself and Safe Harbor Water Power Corp although it had been directed to file alone; (2) the schedule for service to Pennsylvania P&L and Philadelphia Electric violated the order by limiting the availability of service; (3) the schedule for Consolidated of Baltimore failed to provide for a credit of $141,777 as directed in the Jan 5 order; and (4) no provision was made for adjustment of rates with variations in the cost of fuel.

Pacific Gas & Electric Co's new contracts with nine California cities have eliminated ratchet clauses to provide for slightly lower rates on wholesale power. Decreases vary from 1.4% to 5%. The largest annual decrease will be an estimated $25,000 for Alameda. Other cities affected are Biggs, Gridley, Heraldsburg, Lodi, Lompoc, Palo Alto, Santa Clara, and Ukiah. The wholesale agreements were revised to conform with a contract offered this spring to Redding, providing for a 10% cut along with elimination of the ratchet clause to meet a special competitive situation. The Bureau of Reclamation had offered Shasta power to the city at rates well below the PG&E schedule.

Franklin County PUD, Pasco, Wash., will reduce its power rates Dec. 1. Under the new schedule residential rates will be cut an average of 7% while commercial and industrial rates will drop an average of 10%. Largest reduction will be in irrigation rates, nearly to a cost basis.

Central Hudson Gas & Electric Corp has been authorized by the New York Public Service Commission to increase its electric rates by an estimated $155,000 annually. The new rates were to go into effect on or about Dec 1, after the company had submitted a schedule to its customers.

Kentucky-West Virginia Power Co has been authorized by the Kentucky Public Service Commission to increase its rates to industrial consumers by about $309,000 annually. The charges went into effect March 21 after the company had posted bond to assure refunds in case its petition were denied.

Cleveland Electric Illuminating Co's rates for power to Cleveland Transit System have been increased 17½% under a new contract agreed to Nov 17. The contract, which must be approved by Cleveland City Council, is retroactive to Aug 2. It cannot be canceled for two years. An escalator clause permits CEI to increase the rate in case fuel costs go up. The new contract is expected to cost CTS about $100,000 annually.

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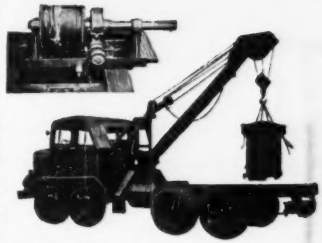

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LETTERS TO THE EDITOR

Clothes Dryers Profitable

To the Editor of ELECTRICAL WORLD:

Your recent editorial on the electric clothes dryer prompts us to advance a few observations from our own experience. The Detroit Edison Co has investigated the load characteristics of this appliance with tests on 72 dryers chosen at random from the some 1,200 connected to our system. The highlights of this report are summarized as follows:

	30 Minute Integrated Values	
Coincident maximum demand per dryer—kw	Winter	Summer
Test period	0.96	0.66
Average Monday	0.86	0.76
Average weekday (Monday through Friday)	0.38	0.30
Time of occurrence—period ending	11:30AM	12:00M
Non-coincident maximum demand per dryer—kw	4.21	4.21
Load factor (Based on average Monday maximum)	10.4%	
Individual load factor	2.1%	
Annual energy consumption	782 kwhr	

Since the kwhr use is significantly dependent on family size the test data have been adjusted to the average U. S. family (3.8 persons).

The electric home laundry is undoubtedly an integral part of electrical living, but the position of the clothes dryer is not as obvious as you have implied. Recent surveys show that the automatic washer and the electric clothes dryer definitely go together. There is, however, no correlation with the electric water heater particularly in urban areas where natural gas is available. In suburban and rural areas where we already have better than 10% saturation of electric water heaters, it will be interesting to see if the clothes dryer installations expand accordingly.

Since there is some indication that the clothes dryer may prove to be concentrated in urban areas perhaps we should consider it in tandem with the electric range. Both are heavy-duty appliances with relatively poor load factors and there is a substantial saturation of ranges in homes having clothes dryers. The morning use and peak of the clothes dryer will tend to counterbalance the high evening peak of the range.

Coming now to your investment calculations, we have been unable to reconcile a 15% capitalization of gross revenues. Since 1939, a period in which our gross revenue has doubled, our fixed assets have been increasing at the rate of $1.50 per dollar of added revenue on a system wide basis. Our analysis of the clothes dryer as a profitable load shows that we can ex-

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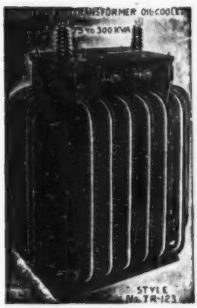

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pect to invest about $3.00 per dollar of added revenue instead of the $7.00 that you have projected. The additional investment allocated to this load is primarily for generation and transmission facilities with the distribution system absorbing the increased load virtually without any strengthening.

We again agree that the clothes dryer is an integral part of the electrical living which we want to promote, but this new load must be handled with a reasonable capital outlay if we wish to stay in business *at a profit*. Capitalized at 15% the utility would barely recover its direct operating costs without anything being available for return on the investment.

Eldred H. Scott
Assistant Controller
The Detroit Edison Co

Equivalent Inductance

To the Editor of ELECTRICAL WORLD:

In your issue of the 30th July 1949 (page 84) an error appears in the article "Condenser Supplies Power for Testing Circuit Breaker." In line 14 you say "and the total inductance (equivalent to that of the alternator)". Actually, and as we said in our report upon which the article was based, it should be "the total inductance (including an inductance equivalent to that of the alternator)". This means that there was an inductance in the circuit in addition to the inductance equivalent to that of the alternator.

O. V. Onslow
Information Officer
The Electrical Research Association

Felicitations

To the Editor of ELECTRICAL WORLD:

Our company feels highly flattered that you saw fit to use five of our items in the October 22 Cost Cutting issue of ELECTRICAL WORLD. We saw this copy and there was considerable discussion in the operating department regarding further improvements in our own organization.

Frankly, we think that this idea is invaluable as a means of working up enthusiasm in the organization for cost cutting, as it gives us an opportunity to (1) survey our own departments and call to their attention, by implication, how well they are organizing, and (2) when the article is published to compare our ideas with others as well as obtaining new ideas.

We sincerely hope that you make this an annual feature, and should you do so, we expect to use this as one means of stimulating our people to do a better job.

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BOOK REVIEWS

Simplified Electricity for Utility Workers. **By P. R. Rutledge. Published by Delmar Publishers, Inc, Albany, N. Y. 10 letter-size pamphlets in ring binder, totalling 360 pages, illustrated.**

Developed as a training course for employees who do not have technical education, this work is an admirable presentation of what these employees should know about the business they are in. The subject matter, using only arithmetic and that very limited in amount, offers a practical, down-to-earth, explanation of the generation, transmission, distribution and metering of electricity. It covers the operation of the main equipment used in the industry and the meaning of the electrical terms the employee hears every day. Additionally it defines the place of the utility in the community, describes its functions, and relates its history and growth in our system of free enterprise. Titles of the 10 units comprising the course are: (1) Our Job with the Power Company; (2) Magnetism; (3) Introduction to Practical Electricity; (4) The Terms We Use; (5) Sources of Electrical Energy; (6) How Alternating Current Behaves; (7) Electric Motors; (8) Transformers; (9) Instruments and Meters; (10) Generation, Transmission and Distribution.

Overhead Line Practice. **By John McCombe. Published by Macdonald & Co., Ltd, London, EC 4. 269 pages, illustrated. Price 25/- net.**

Definitely design rather than operation or maintenance. The practices reflected are those of the British Isles as to loadings, specifications and structural preferences. Despite this variance, for an American engineer the treatment is more complete and intelligently instructive as to both transmission and distribution supports and conductors than is correspondingly available here. Above all, included are many numerical examples of mechanical solutions.

Basic Electronics. **By R. G. Kloeffler and M. W. Horrell. Published by John Wiley & Sons, Inc. New York 16, N. Y. 435 pages, illustrated. Price $5.**

The power engineer or student with "power major" were uppermost in the intentions of the authors in framing this non-mathematical and simple treatment of electronics. In adhering to this objective they have assembled for early qualitative discussion many of the more recent phenomena which in other elementary books are reserved for later treatment if at all. Equipment circuits and tube assemblies are approached from the phenomenon and characteristics angle, facilitating the understanding progressively of amplification, coupling, oscillation modulation, rectifiers, filters, photo-electricity and television.

Industrial High Frequency Electric Power. **By E. May. Published by Chapman & Hall, Ltd, London W.C. 2. 355 pages, illustrated. Price 325-net**

Just about half the book is devoted to the fundamental circuits and apparatuses for producing high frequency power before taking up the quantitative aspects of induction heating. In sequence come dielectric heating and the requisite auxiliary equipments and the high frequency measurements. Closing subject matter applies the preceding formulas and precepts to such industrial operations as melting, forge-heating, case-hardening, carburizing, automatic soldering, textile-drying.

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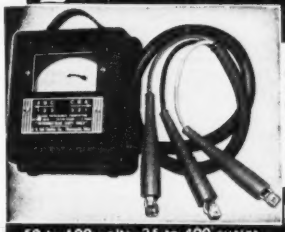

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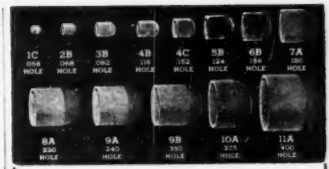

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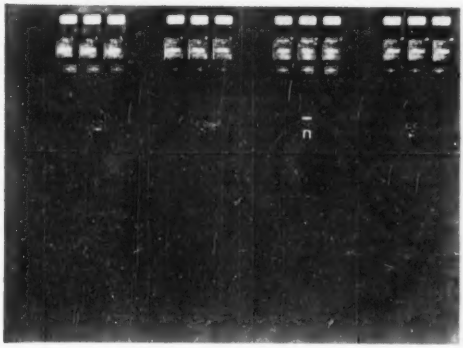

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KVA	Make	Type	Volts	Speed
5140	Whse.		2400/4150	600
4000	G E.	TSC	2400/4150	900
3000	Whse.		2400/4800	720

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3 ph. 60 cy.

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1500	G.E.	360	275	2200/4400
1500	G.E.	600	600	2300/4150
1250	G.E.	600	275	4150
1000	Whse.	900	600	4150

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Kva	Make	Type	Ph	Voltages
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2500	G.E.	DTQ	1	13200x3300
2500	Al. Ch.	OISC	3	13200x2300
2500	Pack.	AT	3	13800x2300
1250	G.E.	HVDDJ	1	6600x550
1250	Maloney	C	1	4160x240-480
1000	G.E.	HTI	3	13200x480
1000	Pitts.	OISC	1	13200x2300
750	Whse.	OISC	3	33000x2300
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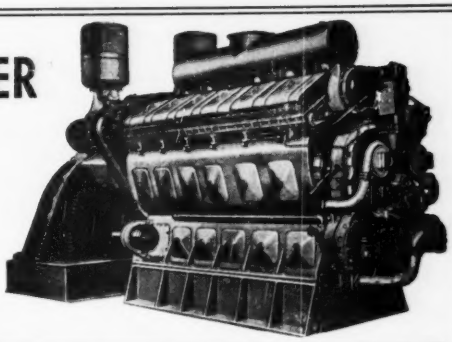

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937.5	General Motors	12-567	1080	720	187	Ingersoll Rand	S	225	514
625	Alco	6-12½x13T	750	600	125	General Motors	3-268A	150	1200
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TYPE CAN
combination Polyphase Watthour
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...even where the load is small!

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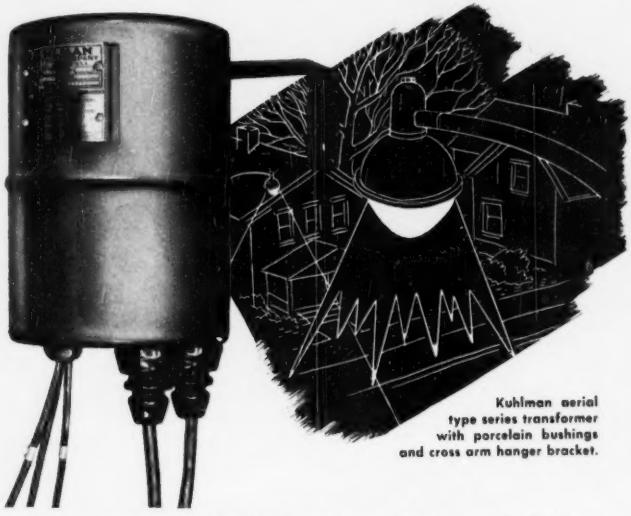

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✓ **Long-Life.** All welded, copper alloy case construction makes transformers moisture-proof and corrosion resistant. When desired, transformers for underground service can be equipped with galvanized cases.

✓ **Simple Installation.** Flexible leads through porcelain bushings facilitate connection to lines for aerial mounting. For vault and underground service, conduit nipples or waterproof, bayonet type cable disconnects are available.

✓ **Economy.** In addition to increasing lamp life, Kuhlman Series Transformers practically eliminate maintenance costs. Install them, forget them!

Kuhlman Series Transformers are available for vault, manhole, lamp base or aerial mounting. Write for full details.

Kuhlman ELECTRIC COMPANY
BAY CITY, MICHIGAN

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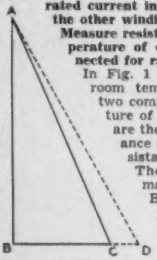
TRANSFORMER TOPICS by KUHLMAN

QUESTION: How do you calculate the copper loss and percent impedance of a two-winding transformer at 75°C, from measurements made at temperatures around 25°C?

ANSWER: Measure impedance volts and copper load loss at room temperature at rated current in one winding with the other winding short-circuited. Measure resistance at room temperature of each winding connected for rated voltage.



In Fig. 1 the impedance at room temperature AC has two components in quadrature of which AB and BC are the percentage reactance and percentage resistance respectively. The reactance remains unchanged but BC varies with temperature and becomes BD at 75° C. Combining BD with AB, the impedance at 75°C becomes equal to AD.

$$AC = \frac{100 \times \text{impedance volts @ room temperature}}{\text{nominal voltage of winding on which impedance volts were impressed}}$$

$$BC = \frac{100 \times \text{watts copper loss @ room temperature}}{\text{volt ampere rating of transformer}}$$

$$AB = \sqrt{AC^2 - BC^2}$$

BC has two components: I^2R (current squared times ohms resistance in both windings) and stray loss. The former varies directly with the temperature and the latter inversely with the temperature.

Stray loss, therefore, is the measured load loss minus the calculated I^2R for a given temperature.

The correction factor for temperature

$$K = \frac{234.5 + t_2}{234.5 + t_1}$$

Where t_1 and t_2 are two temperature levels in degrees centigrade.
Where t_2 = 75°C and room temperature t_1 = 25°C

$$K = 1.192$$

Load loss corrected to 75°C from 25°C = $I^2R \times 1.192$ + Stray Loss × 1.192

The load loss component of the impedance at 75°C is therefore

$$BD = \frac{100 \times \text{load loss at } 75°C}{\text{KVA} \times 1000}$$

Where it is inconvenient to measure the resistance of either or both windings, the stray loss at room temperature may be conservatively estimated at one watt per rated KVA for distribution transformers, 100 KVA and below with 120/240 secondary volts

Numerical example.

100 KVA 2400/4160Y — 120/240 volt transformer with the following characteristics at a temperature of 25° C.
Copper loss watts = 1026
Impedance volts = 69 (on 2400 volt winding)
Resistance of H.V. = .276^W
Resistance of L.V. = .00256^W (on 240 volt connection)

Referring back to Fig. 1 $\%IZ$ @ 25°C = $\frac{69 \times 100}{2400} = 2.88 = AC$

$\%IR$ @ 25°C — $\frac{1026 \times 100}{100000} = 1.026 = BC$

$\%IX$ — $AB = 2.88^2 = 1.026^2 = 2.68$

I^2R @ 25° = $(41.6^2 \times .276) + (416^2 \times .00256) = 920$

Stray load @ 25°C = 1026 — 920 = 106

I^2R @ 75°C = 920 × 1.192 = 1100

Stray Load @ 75°C 106 × 1.192 = 89

Copper loss @ 75°C = 1100 + 89 = 1189

$\%IR$ @ 75° = $\frac{1189 \times 100}{100000} = 1.189 = BD$

$\%IZ$ @ 75° = $2.68^2 + 1.189^2 = 2.93 = AD$